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CONCORD SHOPS—BOSTON & MAINE RAILROAD.

Last month a general description of these shops, illustrated with an inset, was presented simultaneously in the "American Engineer,' and the "Railroad Gazette," by special arrangement. The description is continued in both papers by a presentation of some of the features of the locomotive shop and planing mill. The electrical work, including the generators and motors, the power-house and the steam distribution systems, will be described in a subsequent issue.

LOCOMOTIVE SHOP.

The machine, erecting, boiler and tank shops for locomotive work are all in one building. The erecting shop occupies the central portion of the main building, which is 305 feet long by 130 feet wide. The wings, 30 feet wide, on each side, are used for the machine shop, while the boiler and tank shop occupies an extension of the central portion of the building, 105 by 70 feet at the south end. This arrangement is admirable, and is worthy of attention by all who are contemplating the building of new shops. Its chief merits are concentration of all of the locomotive work in a one-story building, without separating the parts of the shop unduly and an excellent track arrangement combined with a convenient and efficient crane system, which is made to serve alike the main locomotive shop and the boiler shop. The whole plan is specially well adapted to electrical distribution, and the arrangement of the machinery in two wings renders it easy to subdivide the power into favorable units.

The advantages of three longitudinal pit tracks in the erecting shop as well as that of extending one of them through the entire building from end to end have been already noticed. The plan adopted for these shops has the additional recommendation of placing the locomotives very near where the work is done. It will be understood that locomotives are taken into the shop on the center track, where they are dismantled, after which they are taken across to one of the work tracks by the electric cranes as illustrated in the accompanying photograph, showing a locomotive in the air. There is room for seven locomotives on each of the work tracks, making fourteen that may be given general repairs at once, and in case of emergency the center track may also be used for repair work.

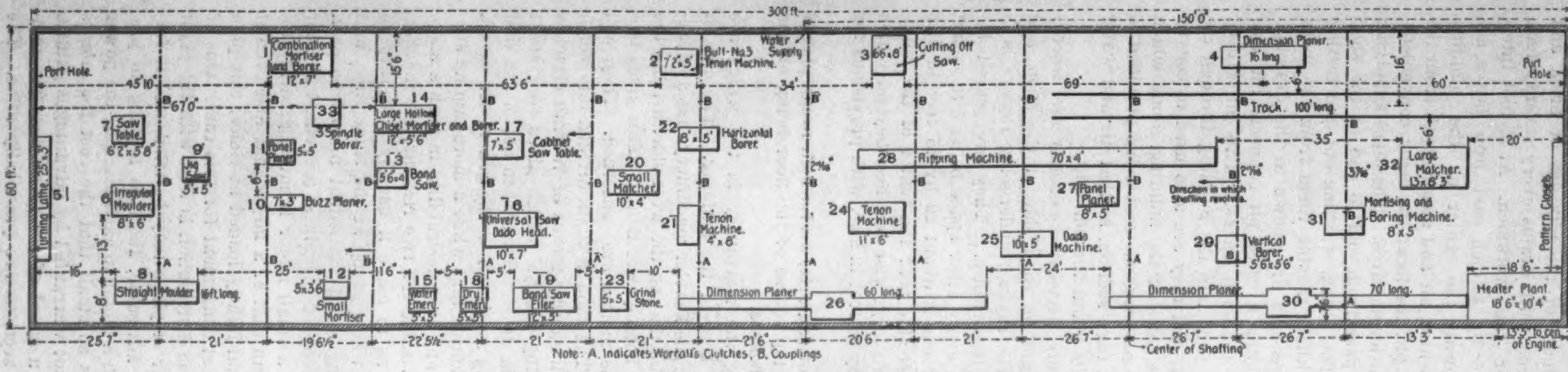
The rails for the work tracks are laid on heavy stringers, which are supported by 16-inch brick walls, forming the sides of the pits. The floors of the pits are of brick and are divided into water sheds, with drains every seventy feet, to insure dry floors for the workmen. At 35-foot intervals pockets made of 16 by 40-inch cast iron boxes are located in the pit walls toward the center of the building and to these are brought water, air and steam pipes from the supply pipes in the center pit, the locations being conveniently near the fire boxes of the locomotives. The pipes supplying these pocket connections pass from end to end of the shop through the center pit. The filling, washing out and testing of boilers may be done without moving them from the work tracks. These pits and pockets are shown in the drawing. At the center of the building a cross pit connects the two steam heating coils under the shop tracks. This pit is used for the heater pipes that come into the building through the pit under the center track, and they are also used to convey air and water pipes to the sides of the building, along which these pipes extend on the roof trusses, tees being provided to bring them to the floor at each section, so that air and water may be had at many points about the building.

The numerous and easily accessible benches are worthy of notice. There are eight on each side of the shop, and their close proximity to the engines undergoing repairs is a matter of considerable importance. They are placed between the crane supports, every other space being left vacant for gangways. The toolroom is about 20 by 45 feet in size and is located on the west side near the center of the building. South of this are two large vise benches, beyond which is the air-brake room, 20 by 20 feet in size, with provisions for holding 30 pumps at once. BENCHES

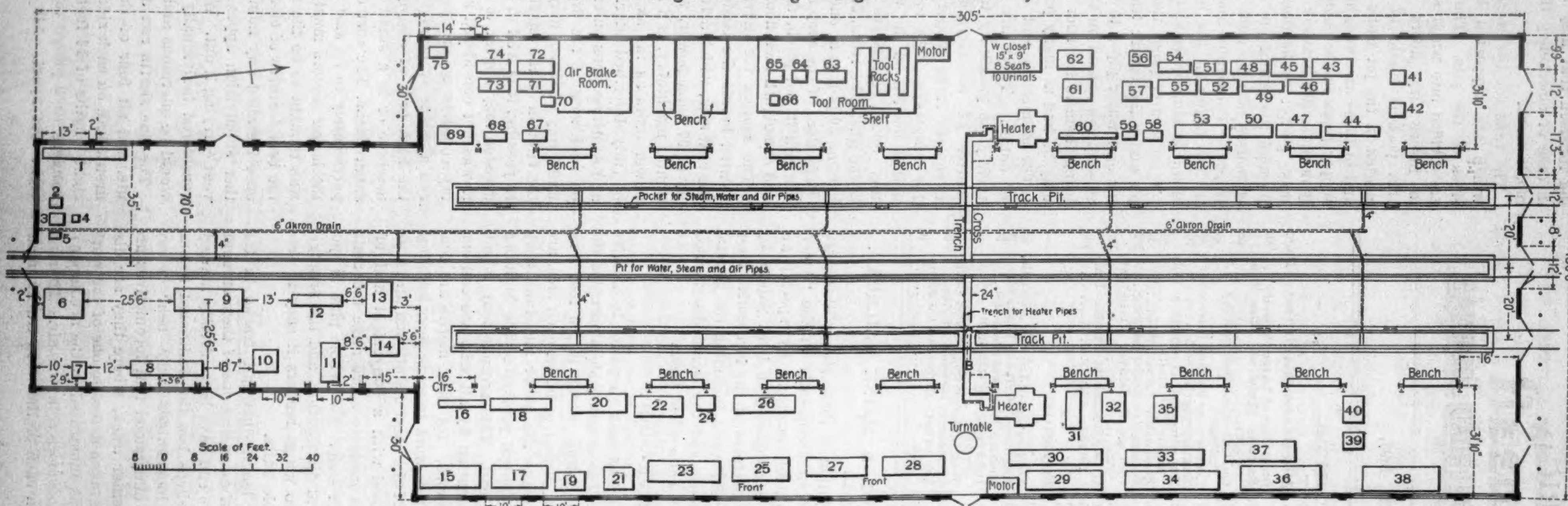
The floor of the shop is of concrete, over which rough planks are laid in hot pitch, the top course of the floor being of one and one-eighth inch floor boards. FLOOR

The motors for driving the machinery in the wings are located beside the center door of the building. The one on the east side, which drives the heavier machinery, has a capacity of 30 horse-power, while that on the west side, driving the lighter machinery, is a 20 horse-power motor. This gives two power units as far as the motors are concerned. They will be fully described later. The shop is again divided into north and south sections on each side by means of Worrall clutches on each side of the driving pulleys, which gives four shaft units, any of which may be disconnected when not in use, and the friction of the shafting as a load on the generators saved. In passing, it is well to mention that while a more minute subdivision may appear to many as a desirability in such a shop, it was not considered advisable for two reasons; the machinery could be so grouped as to make it usually necessary to run a whole or nearly a whole group at the same time, and the high cost of supplying small individual motors to each machine or to a small group of machines, prevented further subdivisions. The cost of a small motor is much greater proportionately to its size than that of a larger one, and even if the larger motors must run lightly loaded at times, this plan was thought to be the most convenient for this case. One of the best features of electric distribution is that with the plant once installed any number of plans may be tried, and if further subdivision appears advisable, there is nothing to prevent carrying it out. With a motor to each machine the power considered individually is so small that the cost for motors would be enormous and not warranted by advantages gained.

The line shafts run at a speed of 200 revolutions per minute, and all four of the sections are practically alike. The first length on each side of the clutches is 12 feet, followed by eight lengths of 16 feet. The supports are double brace-drop hangers, each placed four feet on either side of the trusses, or eight feet apart. All main-line shafting in this building is



Plan of Planing Mill Showing Arrangement of Machinery.

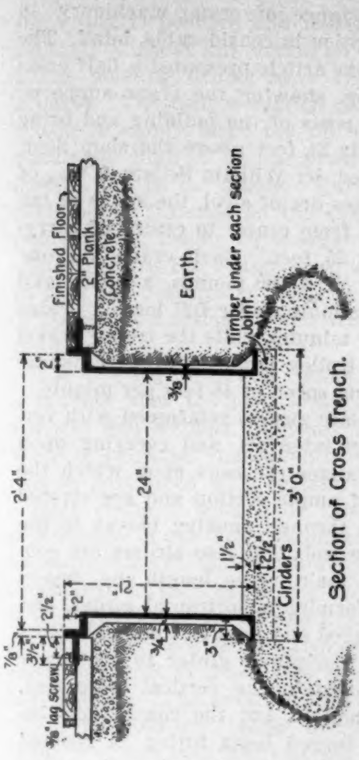


Plan of Locomotive and Boiler Shops Showing Arrangement of Machinery.

KEY TO TOOL LOCATIONS—MACHINE SHOP.

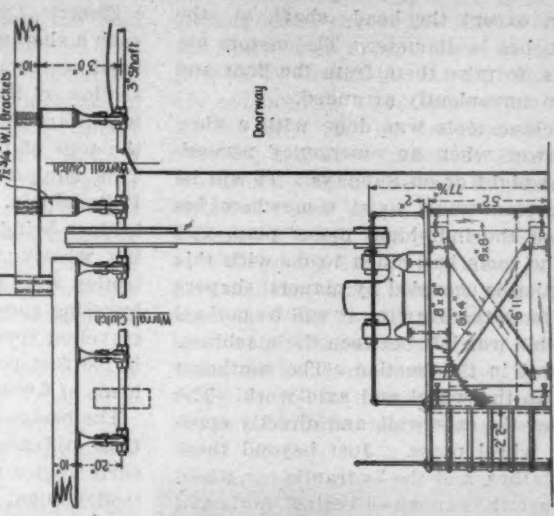
1. Flue tester.
2. Drill press.
3. Tube welder.
4. " " furnace.
5. " cutter.
6. Shear.
7. Punch.
8. Plate planer.
9. " rolls.
10. Radial drill.
11. Flanged punch.
12. Clamps.
13. Flanging forge.
14. " block.
15. Car-wheel lathe.
16. Wheel press.
17. Car-wheel lathe.
18. Lathe.
19. Car-wheel borer.
20. Lathe.
21. Car-wheel borer.
22. Lathe.
23. Car-wheel lathe.
24. Grinder.
25. Driving-wheel lathe.
26. Driving-wheel press.
27, 28. Driving-wheel lathes.
29, 30. Planers.
31. Radial drill.
32. Slotter.
33, 34. Planers.
35. Slotter.
36, 37, 38. Planers.
39, 40. Shapers.
41, 42. Drills.
43 to 55, inclusive. Lathes.
56, 57. Boring mills.
58. Grinder.
59. Centering ring.
60. Speed lathe.
61. Drill.
62. Slotter.
63, 64, 65, 66. Lathe, milling machine, tool grinder, and twist drill grinder.
67, 68. Bolt cutters.
69. Screw machine.
70. Drill.
71, 72. Brass lathes.
73. Speed lathe.
74. Fox turret lathe.
75. Nut tapper.

CONCORD SHOPS.—BOSTON & MAINE RAILROAD.

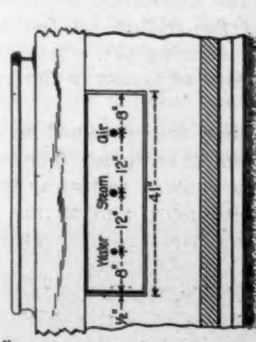


Section of Cross Trench.

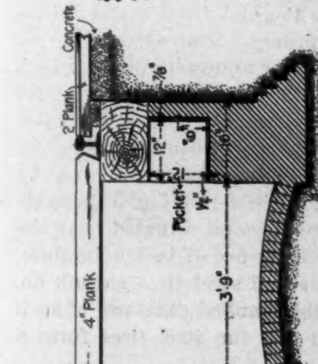
Section of Cross Trench for Steam Pipes.



Mounting for 30-Horse-Power Motor.

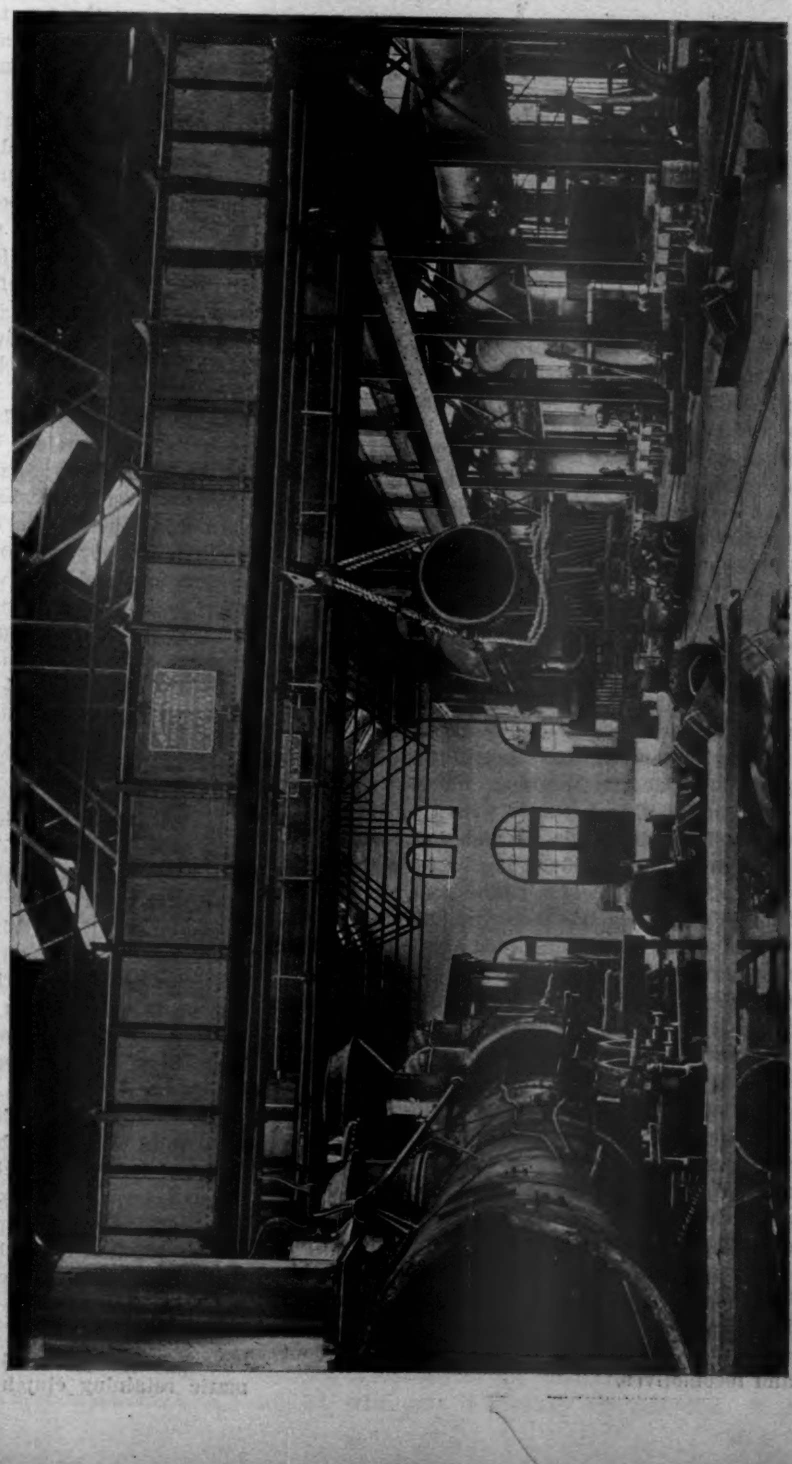


Inside Elevation Showing Pockets for Piping.



Cross Section of Track Pits.

Sections of Track Pits.



View of Locomotive Shop, Showing Cranes in Use.

CONCORD SHOPS,—BOSTON & MAINE RAILROAD.

2 11-16 inches in diameter, except the head shaft, at the clutches, which is 2 15-16 inches in diameter. The motors are mounted on wooden frames, to raise them from the floor and the switches and fuses are conveniently arranged.

The grouping of the machine tools was done with a view to economy in use of power when an emergency necessitates running "overtime" at night or on Sundays. It will be seen that an ideal arrangement must exist somewhere between the single motor and the individual motor plan, and that the arrangement of the tools has much to do with this question. The northeast section is occupied by planers, shapers and milling machines, and from the drawing it will be noticed that as much space as possible was left between the machines. One of the heaters is located in this section. The southeast section is wholly given up to the wheel and axle work. The driving wheel lathes are near the east wall, and directly opposite is a 300-ton hydraulic wheel press. Just beyond these are the axle and crank-pin lathes, and the hydraulic car wheel press, while opposite these are the car wheel boring mills and wheel lathes. This work is kept in one section, because wheel work forms the most important class of repairs; many engines come in for this work that are in fair condition otherwise. The northwest section has the engine lathes in two double rows, with universal drills, milling machines and boring mills at the south end. The water closets are located at the south end of this section, as shown on the plan. The southwest section, besides providing for the tool room and air-brake room, contains the brass working tools and bolt cutters. The bolt cutters are so arranged as to admit car and tender truss rods 40 feet long. At the vise benches, between the tool and air-brake rooms, 18 men are accommodated.

The arrangement of the boiler and tank shop appears on the plan. The shafting and machinery is driven from the southeast section of the machine shop by tight and loose pulleys, except the large rolls, which are driven by a direct connected 20 horse-power Westinghouse motor. The tools in this shop are all modern, and their locations provide for handling large boiler plates, some of which are nearly 8 by 23 feet in size. There are flange and straight punches, a plate planer, rolls, drills and bending clamps. The heavy lifting in this shop is done by the large electric cranes, while pneumatic hoists, post cranes and runways are employed throughout the shop for light work. The west side of the boiler shop is left vacant except at the extreme south end, where the flue scarfing, welding and testing machines are placed. The flue rattler is outside the building near this corner.

Of the machinery in this shop the Putnam Machine Company, of Worcester, Mass., furnished a No. 2 universal milling machine and the 300-ton hydraulic press. The Pond Machine Company, through Messrs. Manning, Maxwell & Moore, of New York, furnished a 36-inch planer with two heads; the Niles Tool Works, of Hamilton, Ohio, furnished one set of No. 4½ bending rolls to take plates 12 feet long between the housings, the rolls being 12 and 9 inches in diameter, driven, as stated, by a 20-horse power electric motor, a universal radial drill with five-foot arm and swiveling head, a pair of bending clamps for 12-foot plates and a plate planer to plane plates 12 feet long at one setting, and plates of any length by resetting, the carriage cuts in both directions. Messrs. Long & Alstatter, of Hamilton, Ohio, furnished a No. 2 flange punch with a seven-inch throat, capable of punching a one-inch hole in a one-inch plate and having a pull-off attachment. They also furnished a single punch and shear with 48-inch throat. Messrs. Bement, Miles & Co., of Philadelphia, furnished a 46-inch double car wheel lathe, used for wheels 42 inches in diameter. This has a caliper attachment and it is reported to average one hour five minutes in turning a pair of steel tired wheels. The other machinery is shown on the plan of this shop and the locations and list of tools are numbered to give an idea of their arrangement. This shop is lighted by 28 arc lamps and there are also 75 incandescent lights in use about the machines and locomotives.

Electric Cranes.—The importance of crane machinery in such a shop warrants a description in considerable detail. The inset accompanying the previous article presented a half cross section of the locomotive shop, showing the crane supports, which are independent of the posts of the building and bring the tops of the traversing rails 24 feet above the shop floor. This equipment was furnished by William Sellers & Co., of Philadelphia. The crane bridges are of steel, the spans of the bridges being 66 feet 4 inches from center to center of carrying wheels, while the lift is 25 feet. Each crane has one trolley with a lifting capacity of 60,000 pounds, a lifting and lowering speed of 12 feet per minute under full load, a bridge traveling speed of 200 feet per minute, while the trolley travel is 100 feet per minute. The trolley is also geared to handle loads of 6,000 pounds at a lifting speed of 48 feet per minute.

The bridge consists of two plate girders reinforced with vertical stiffening angles at short intervals, and carrying upon shelf angles near the lower flanges the rails upon which the trolley runs; these rails are of ample section and are riveted to the shelf angle and bolted through packing blocks to the stiffeners on the outside of the web. The two girders are connected over the top through their entire length by heavy cross and diagonal bracings, forming a horizontal girder, and at their ends by diagonally braced end frames; diagonal struts from the cross braces of the horizontal girder to the lower chords of the main girder maintain the vertical alignment. Each girder is riveted up complete, but the connections between them are secured by turned bolts fitting in reamed holes, avoiding the necessity of field riveting when the crane is erected. The steel used in the bridge has an ultimate tensile strength of about 60,000 pounds per square inch, an elastic limit of 50 per cent. of the ultimate, and an elongation of 20 per cent. in eight inches. The bridge parts are so proportioned that the maximum strains will not exceed 10,000 pounds per square inch in compression and 12,000 pounds in tension with the full load, and due allowance is made for strains produced by the inertia of the trolley. A foot-board or gallery is provided on one side, running the whole length of the bridge, affording an easy means of access to the bridge motor and squaring shaft.

In this construction the two girders are combined to form a single compound beam of great lateral stiffness. The bridge girders are made to project over the runway rail so as to rest thereon in case of accident or derailment, and as the drop would only be about an inch no harm would result even if the crane were carrying the full load.

The bridge is carried upon four wheels, which are fast upon short axles, the bearings for which are placed on both sides of the wheels and are attached to the end frames and bridge plates projecting from the bridge girders. The vertical thrust of the axle bearing is taken upon heavy abutment plates, which are riveted to the bridge. The axle bearings are provided with grease boxes filled with woolen waste. One of the axles at each end is provided with a large gear wheel connected by a suitable train of gearing with a driving shaft extending the whole length of the bridge, supported in self-oiling, adjustable bearings, and the shaft is driven by a motor situated near the center of the bridge. The bridge wheels are 37 inches in diameter on the tread, with cast centers and steel tires shrunk on. The wheels are provided with double flanges. The use of such large wheels insures easy driving and the steel tires form a durable tread.

The trolley with its hoisting and traversing machinery runs upon rails within the bridge. The frame or housing is composed of built-up steel beams and plates resting directly upon the axle bearings. Upon its upper surface it carries the various bearings for the drum shaft and machinery. The trolley wheels are fast upon the axles and are 21 inches in diameter, steel tired, with double flanges. All the pinions in the hoisting train are of steel, and also the large gear-wheel on the drum. All high-speed gears have cut teeth. There are no bevels, worms or worm-wheels. The Sellers' well-known automatic retaining clutch forms a part of the hoisting train;

its action is positive and noiseless and it supports the load securely without any action on the part of the operator.

The hoisting drums have right and left-hand continuous grooves. The load is carried on four parts of one-inch chain, which is amply large for the work, and has a large factor within the limit of its test proof-load; it is of Bradlee & Co.'s special "D. B. G." grade. Two chains are used, one end of each being fastened to the drum and the other to a fixed point on the trolley by means of an eye-bolt, permitting the adjustment of the chains to equal length. The chains are laid so that the pressure is brought on each link in the direction of its greatest strength, and without tendency to deform the chain.

The hoisting drum and chains are arranged to wind in such a manner that the load must always raise and lower in a vertical line without tendency to twist the block or to traverse it sidewise, consequently the most delicate movements can be performed with certainty.

Each crane is worked by three two-phase alternating current motors of the Tesla induction type, furnished by the Westinghouse Electric and Manufacturing Company. A No. 4 motor is applied to each crane for hoisting and lowering, a No. 3 is used for bridge travel and a No. 1 for the trolley travel, six motors being used for the two cranes. These motors are similar in general to those used to drive the shops, except as to the winding. The crane motors are not of the constant-speed type, this feature being sacrificed to a certain extent in order to obtain sufficient starting torque in the lifting of heavy loads. The variation in the speed is about 30 per cent. from the normal of the constant speed motors of these sizes.

The motors operate on 400-volt circuits with two-phase currents having 7,200 alternations. Each motor has a Westinghouse controller placed within easy reach of the operator. Each motor has three fuses and a treble pole-knife switch.

THE PLANING MILL.

The planing mill was the subject of considerable study with particular reference to the arrangement of the machinery in order to avoid all unnecessary handling of material. This building is by far the most interesting of those of the car department, and it will be the only one described in detail.

By reference to the inset accompanying the previous article

Passenger Car Paint Shop Showing Stagings.

it will be seen that one of the yard tracks enters the north end of the mill and extends a distance of 100 feet into the building. This is for the purpose of taking loaded cars directly to the first machines upon which the heavy work of the mill is done. Power is supplied by a 125-horse power Armington & Sims engine, running at a speed of 268 revolutions per minute, located in the northwest corner of the power house and belted directly to the shafting of the mill. This is the only case in the whole plant where an engine is directly belted to its machinery and in this case advantage was taken of the favorable location of the mill for the direct connection. The shafting of the mill is in 12 transverse lengths spaced about 20 feet apart, except the three lines at the north end. All of the shaft lines except three have Worrall's clutches for the purpose of cutting out the friction of the shafts and belts that are not needed. The location of these clutches are indicated by the letter "A" on the plan of the mill. The planing mill shafting is 2 11-16 inches in diameter except the head shaft, which is 3 7-16 inches, and the lines of shafting are belted in series.

The mill is 300 feet long by 60 feet wide, which is a favorable shape for handling lumber in a regular course from the first machine to the last one used upon it, without either placing it upon the floor or retracing any of the movements. The location of the building is also favorable to economical operation, as it lies between the dry house and the car repair shops. It will be of interest to follow the programme of operations of certain materials passing through the mill. Side

Planing Mill from North End.

sills represent a class of parts to which intermediate and center sills, side plates and other long pieces belong. These are brought to the end of the shop on push cars or in carload lots. The pieces enter the shop through a port hole through the wall in the northwest corner of the building, as seen in the plan. This port hole is provided with rollers over which the timber passes on its way to the large Berry & Norton four sided planer (indicated as No. 4 in the plan), which is placed 60 feet from the north end of the shop. Here the sills are planed on four sides to the required dimensions and the ends are cut off and squared on the cutting off saw, No. 3, 69 feet beyond the planer, the distance being sufficient for timber 70 feet long without backward motions. The timber next passes in a direct line to the bull-nosed tenoning machine, No. 2, where it is tenoned. It is then placed on horses and "laid out" or marked for further work, whereupon it goes either to the combination mortiser and borer, No. 1, or to the large hollow chisel mortiser and borer, No. 14, for finishing. It passes out of a port hole at the south end of the shop and is received on a push car for the car shop or loaded into a box car for shipment, as the case requires. It will be seen that the heavy timbers are neither laid on the floor nor zig-zagged about the shop, but pass in almost a perfectly straight path from end to end of the building.

It would be interesting to follow the course of draft timbers, which will be sketched very briefly. They enter the shop on push cars. They are planed on all sides by planer No. 4 cut off square at the ends on No. 3, tenoned on No. 2, gained as required and the boring and mortising are done on No. 33, which completes them. They pass out of the mill door on trucks.

Much of the heavy car work for the road will be done here and the handling of large quantities of such material as freight car decking has been admirably provided for. This material is generally two inches thick. It is brought into the mill on a flat car with an empty flat car in front of it. The decking is handed to the attendant of the large matcher, No. 32, who puts it through the machine. A helper hands

it to a laborer on the empty car, where it is loaded for shipment or for use in the repair shop. It would require much space to give the course followed by other parts, but enough is said to show the principle of labor saving employed here, and to call attention to the great importance of planning the arrangement of the machinery with a view of making every motion count in the finished product. Mr. John Chamberlain, Master Car Builder, kindly furnished the plan of the mill and Mr. E. T. Miller, Chief Draftsman in the Car Department, explained its operation. The location of the machinery is shown in the plan and its operation will be clear when the different uses to which the machines are put are considered. These are all indicated on the drawing.

The power plant and its electrical and steam power equipment, the heating and lighting systems will be described in the next issue.

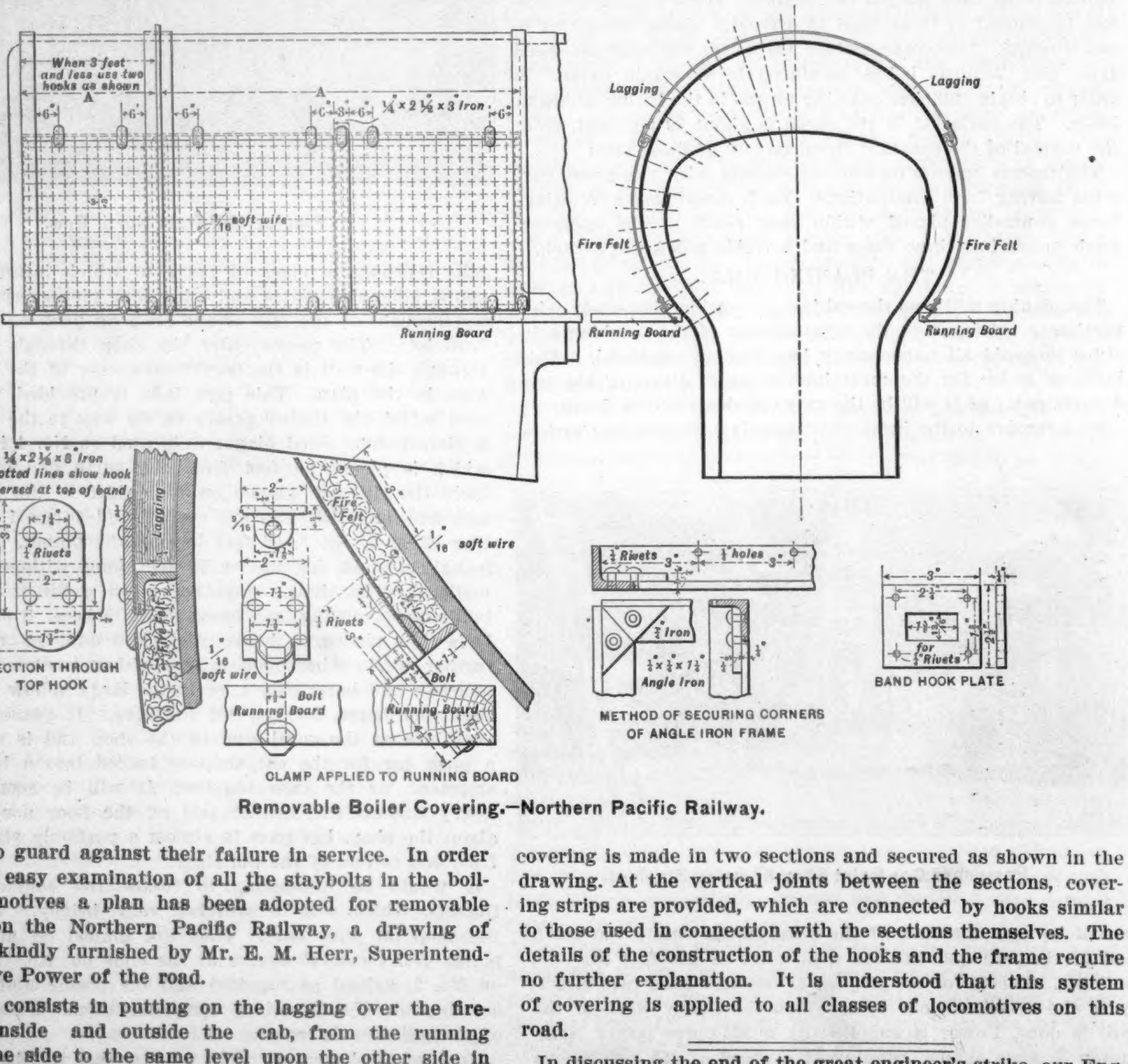
(To be continued.)

REMOVABLE COVERING FOR LOCOMOTIVE BOILERS.

Whatever may be thought of the reasons for the breaking of locomotive staybolts, it is universally admitted that the drilling of test holes and frequent and regular inspection are necessary to guard against their failure in service. In order to permit of easy examination of all the staybolts in the boilers of locomotives a plan has been adopted for removable lagging upon the Northern Pacific Railway, a drawing of which was kindly furnished by Mr. E. M. Herr, Superintendent of Motive Power of the road.

This plan consists in putting on the lagging over the fire-box, both inside and outside the cab, from the running board on one side to the same level upon the other side in removable sections. The object of the arrangement is to render the attachment and detachment of this lagging as easy as possible in order to decrease the difficulty of inspecting the staybolts. The lagging is made up in rectangular panels, three of which attached at their ends extend over the fire-box between the running boards. The sections are framed in 1¼ by 1¼ by ¼-inch angle irons, secured at the corners by ¼-inch iron gussets, riveted to the angles. The two side courses are of fire felt 1¼ inches in thickness, while the longer course, going over the top of the fire-box, is made of the ordinary lagging with a sheet covering. The attachment of the sections is made by means of hooks riveted to the sheets and attachments to the running boards are made by means of bolts and lugs, which may be tightened to any desired extent.

In order to prevent the fire felt from falling out of the frames when removed wire netting of 1-16-inch soft iron wire with 3 by 3-inch meshes is woven into the angle iron frames, ¼-inch holes being drilled through the angles for this purpose. The lengths of the sections of removable covering vary with the different types of engines, and this dimension is shown at "A" "A" in the drawing. (The portion inside of the cab is put on separately, and when three feet or less in width two hooks are used, as shown in the drawing.) For the covering outside of the cab, when the distance "A" is less than 4 feet 6 inches the removable covering is made in one section, secured by three hooks at the top and by three clamps at the bottom of the sections. When the distance exceeds 4 feet 6 inches the covering is made in two sections and secured as shown in the drawing. At the vertical joints between the sections, covering strips are provided, which are connected by hooks similar to those used in connection with the sections themselves. The details of the construction of the hooks and the frame require no further explanation. It is understood that this system of covering is applied to all classes of locomotives on this road.



Removable Boiler Covering.—Northern Pacific Railway.

In discussing the end of the great engineer's strike, our English contemporary, "The Engineer," says: "There is no longer anything to arrest the introduction of such systems of working as will augment and cheapen machinery, and so place us once more in a position to compete with the most go-ahead nation on the fact of the earth." This is a high compliment to the United States.

THE CONSTRUCTION OF A MODERN LOCOMOTIVE.

I.

By Motive Power.

Introductory.

Higher speeds, heavier trainloads, greater economy in fuel consumption and cost of running repairs, and consequent reduction of cost per engine mile, all more or less the result of competition, together with a keener knowledge of the locomotive and its peculiarities, have resulted in the development in this character of rolling stock of a machine which we will term a "modern" machine of its kind, capable of meeting these requirements, and vastly superior and different in much of its detail from the locomotive of years ago. A close observer of the various interests directly concerned with the construction of this type of machinery must have noted that, in a general sense, the progress or evolution from old-time methods to modern ones, born of the creation of the modern locomotive, is of far more recent date than that with which the locomotive of to-day is credited.

In speaking of the constructive side of the question, not only the construction of the engine itself must be considered, but this must be upon such lines as will have a direct bearing on the facility with which running repairs can be kept up and at a minimum cost. Independent of the efficiency of the engine or its economy in fuel consumption and in the interest of low cost of repairs the modern locomotive must be designed and constructed directly with a view of quick and cheap repairs in the roundhouse. Loss of time in the roundhouse will entail a proportionate loss of mileage and consequent earnings of the engine, and a great deal of this time may be saved by adopting designs and methods and a system of construction bearing this phase of the question in mind. Interchangeability of parts, ease of removal of defective parts and replacement of new ones, character of material and workmanship are potent factors in this line of economy.

It is not our purpose to describe the modern locomotive, but rather to deal with its construction, following such modern methods as have been found successful and which bear relation to the points referred to above; nor is it our intention to emphasize the question of cost of manufacture; locality, facilities, price of labor all having a direct bearing on the cost. Questions of methods, rather than cost, will be considered. In the construction of a modern locomotive, and considered from a standpoint of manufacture, the questions of superintendence, raw material, labor, fixed charges and output are vital to the successful operation of the plant, and its organization or subdivision of labor should be such as will provide the minimum number of departments consistent with careful supervision of the force employed in each, and with a view of keeping at a low figure percentage for supervision charged on output.

We desire at this point to impress upon the mind of the reader that he may thoroughly appreciate the aim which we have in view in the following articles, that the most perfect system and complete in its detail is not always the most economical, and that, from the standpoint from which we are going to consider the question, that system is the most economical which has the least amount of detail, requires the least amount of clerical labor, and in its working requires or encourages the least amount of repetition; at the same time providing, in the working of all of its departmental functions, a complete and connective chain of evidence for the purpose of record. In articles which will follow the various departments which we consider necessary for the successful carrying out of the economical construction of the modern locomotive will be considered in detail and under their respective headings. Inasmuch as the system which we propose is entirely controlled and operated by and from the office, that portion of the plant will receive our first consideration.

Office, Drawing Room and Storehouse.

The general arrangement of the plant, governed by the acreage or shape and size of the land on which shops are built, will frequently decide the question of office, drawing-room and storehouse being under one roof. It is, however, our opinion that, as far as the storehouse is concerned, it should be located as near to the shops in which the material is used as possible, and at the same time convenient to siding or track room for the unloading and the shipping of material. For the purpose of making the matter more comprehensive, however, we will consider the office to include the drawing room and storehouse. The office will be considered as divided into three principal departments:

First, the office proper, containing the general office, superintendent's office, with necessary clerks, etc., in which will be conducted all of the general and supervisory business of the plant, and from which all orders and instructions will be issued, and the ordering of all material will be provided for; also a separate or accounting department, coming under the direct supervision of a chief accountant or clerk. In this department all of the accounts and time records of the plant will be kept, pay rolls, bills and costs made out, and such special and general reports and records provided for as shall be deemed advisable by the superintendent. This department should also have charge of all the detail in connection with the paying off of the men employed at the works.

Second, the drawing room, in which should be kept all drawings pertaining to the plant and work under construction; it should be equipped with the necessary force for carrying on such work as would properly belong to this department, and be in direct charge of a competent person, who shall report to the superintendent. As will be hereafter explained more in detail, the drawing room should make out all lists for material, provide piece-work prices, and in a general way furnish from its records and drawings all of the necessary information for the ordering and purchase of material by the general office, as well as the manufacture of that material into the finished product by the shops.

Third, the storehouse, to which should be delivered, either actually or nominally, all of the material received at the works, provided with ample space, shelves and other facilities for the storing of such material of value and of such size as to render it inadvisable to store at other points or in the open air. The storehouse should have full charge of all material received at the plant, whether actually stored within its four walls or at various points throughout the works, and this material remain in the custody of the keeper of stores, who should have full charge and report to the superintendent until it is withdrawn from stock on proper warrant issued to the foreman by the general office. The warrant, on presentation to the keeper of stores, will be a record kept by him of material delivered to any one department. This department should also have full charge of all shipping and should make its reports to the general office. Monthly records of stock on hand and daily records of stock received and consumed are kept in this department. Certain classes of material will of necessity be stored at various points throughout the works where it can be conveniently unloaded, it is thoroughly practicable to have a man in charge of this material, as if it were included in a building, and have his office located at a point near to where the bulk of this material is stored. After the manner of handling stock which is included in the storehouse proper, this material shall be drawn from his custody on the presentation of proper order cards or the ordinary verbal communication on the part of the foreman where the right on the part of the foreman to have this material is demonstrated by its specification on the list in the hands of the man in charge of it. This man should report to the keeper of stores and be under his direct supervision. In this connection it is understood that no material of any kind can be stored under the supervision of any one of the departments outside of the storehouse unless it has been drawn from stock on warrant issued from the general office, and those warrants specifying the order for which it is to be used. Too much stress cannot be laid on the care and storage of raw

material; not only its mere storage, but storage in such a way that the various kinds of material are kept separate, and records of quantities on hand and quantities consumed in any one month provided, which are of such nature that their reliability are beyond question.

Inasmuch as all of the construction in a well-regulated shop is carried on from drawings, it quite naturally follows that a well-conducted drawing room, bearing proper relation to the general office and shops, as it will be shown to bear in these articles, becomes not only an exceedingly important, but one of the first departments in the works to carry out any portion of the system bearing on the construction of the work in hand, and for the purpose of illustration we assume that complete drawings have been prepared for a standard or modern locomotive, and that they have been approved or passed upon by the superintendent of the works as the drawings to be used. These drawings need not exceed, for the large size, 12 by 18 inches, and it has been found that two sizes smaller than this, each a multiple of the larger one, are ample for all purposes. As far as possible, and consistent with the arrangement of departments, these drawings should illustrate groupings of the different operations performed and the different kinds of material used in the various departments, with the distinct purpose in view of avoiding as much duplication of drawings as possible; in other words, it is desirable, as far as possible, to supply each department with drawings illustrating entirely and only the particular part of the work which it has to do.

All drawings should be subject to the approval of the superintendent, generally requiring his signature. They should be clearly dimensioned, but only such dimensions put on as are required in the shop, and it should be distinctly borne in mind that the men who use these drawings are not expected to be mathematicians. Total dimensions over all should be provided and put on the drawings in the drawing room; and it should never be necessary in the use of the drawings in the shop that the men themselves should be required to add or subtract for the purpose of determining an intermediate dimension. Each drawing should contain a note to the effect that any absence of dimension information concerning it must be had from the drawing room before the work progresses further, and under no circumstances should a scale or rule be used for the purpose of determining a missing dimension on a drawing; and in fact, it has been found entirely unnecessary to make any of these drawings to scale. Dimensions should not be changed or placed on the drawings in the shops; where changes or additions are necessary the drawing room should be notified and the changes made there. Where a finish is to be made to gauge a note should be added on the drawing to that effect and the number of the gauge given. Kinds of material should be distinctly specified, and in the case of castings the pattern numbers should be given, or of forgings the forging numbers given. It has been found to be a good plan also to put a note on the drawings to the effect that the number of pieces specified on that drawing are the number required for one engine. The date the drawing is issued, and if it is a detail made from a larger drawing, the number of that larger drawing and its issue, should be inserted. The particular class of engine for which the drawing is prepared can be put on the outside margin, and a blank space, arranged so that it will print white, can be left in the title for the insertion of another class for which it may be desirable to use the drawing. A small black dot on the tracing, and which will print white on the blue print, for the purpose of inserting a shop initial, has been found convenient as a means of preventing the exchange of drawings from shop to shop and their being lost; not because of the value of the drawings themselves, but because, in the event of change of design and the intention to withdraw from the shops drawings which are obsolete to prevent mistakes, they can be traced and returned to the drawing room.

Where changes of design are necessary during construction, the existing drawing should be called in and a new one issued showing such change and a note made on the old one to that effect, giving the number of the new drawing taking its place. The new drawing should also contain an appropriate note indicating that fact, and where special instructions have been issued on the part of the superintendent or the customer for whom the engines are being built, reference can be made on both drawings to the letter or communication, which referred to the change so made. The old drawings should under no circumstances be destroyed, but kept on file. All drawings issued to the shops or to any department of the works should be entered on some form of receipt and receipted for by the foreman of the department to which the drawing goes. These receipts can be printed on a small card, with blank spaces for the entry of the particular drawing and a space for the foreman's signature; the date on which the drawing is issued to the foreman should also be put on this card and a special space across the end of the card left blank provides for the entry of the date of its return. These cards are kept in the drawing room in special compartments, corresponding to the division of the departments of the works, so that at any time an inspection of the cards under any one department will indicate the number and kind of drawings which that department may have, unless it be the case that the cards indicate the drawings as having been returned, in which case the cards will be kept in a separate compartment. These cards are kept on file for one year and then destroyed.

The drawings, being of small size, can be readily mounted on either tin or sheet iron and varnished, and in this way are very serviceable. At the completion of an order it may be convenient to call in a great many of the drawings and remove the prints from these metal backs, using them for the new series. It will, of course, be obvious that in many cases in connection with locomotive work parts are similar in general outline and only vary in dimensions, in which case the dimensions on the drawing proper can be lettered and the various dimensions for different classes of engines tabulated in such way as to reduce the number of drawings which would otherwise be necessary. Fig. 1 illustrates one of the drawings referred to and Fig. 2 a form of receipt card, which will be found satisfactory.

MODERN LOCOMOTIVE COMPANY.

..................................189..

....

Please furnish for use in ....Shop.

for work on Class ....Locomotives ....

....

....

....

Furnished 189

Number....................

Drawer ....

Foreman.

Returned..................189..

Fig. 2.

Possessing, as it does, more complete information regarding the requirements in the way of material and parts than any other department of the works at this stage, the drawing room is required to furnish the general office with the necessary information for the proper ordering of material and parts required, and for this purpose prepares, so that prints can be taken, a list, the headings and vertical divisions of which are shown in Fig. 3. The information on these lists is secured from the drawing room and also from foremen of departments, so that, in their complete form, they contain, in the strictest sense of the word, all of the material required for an engine. In some cases, as, for instance, lumber, nails, paint, varnish, etc., the amounts given on the list for the first order of engines must of necessity be approximate, but by the arrangement of material and credit cards, which will be hereafter explained, any excess can be returned to stock and proper credit given. We would state here that these lists, in their complete form, in the form of prints issued to the general office as information for ordering material, are used in the storehouse for checking up the receipt of material and also govern-

ing the amount of material which can be drawn by the shops. They are also issued to the head of each one of the departments and are a guide to them for the material which they will ask for and draw from the storehouse. This will explain the large number and variety of headings provided, as illustrated in Fig. 3. In the case of the general office, the "Number of Pieces per Engine," "Number of Pieces Ordered," "Kind of

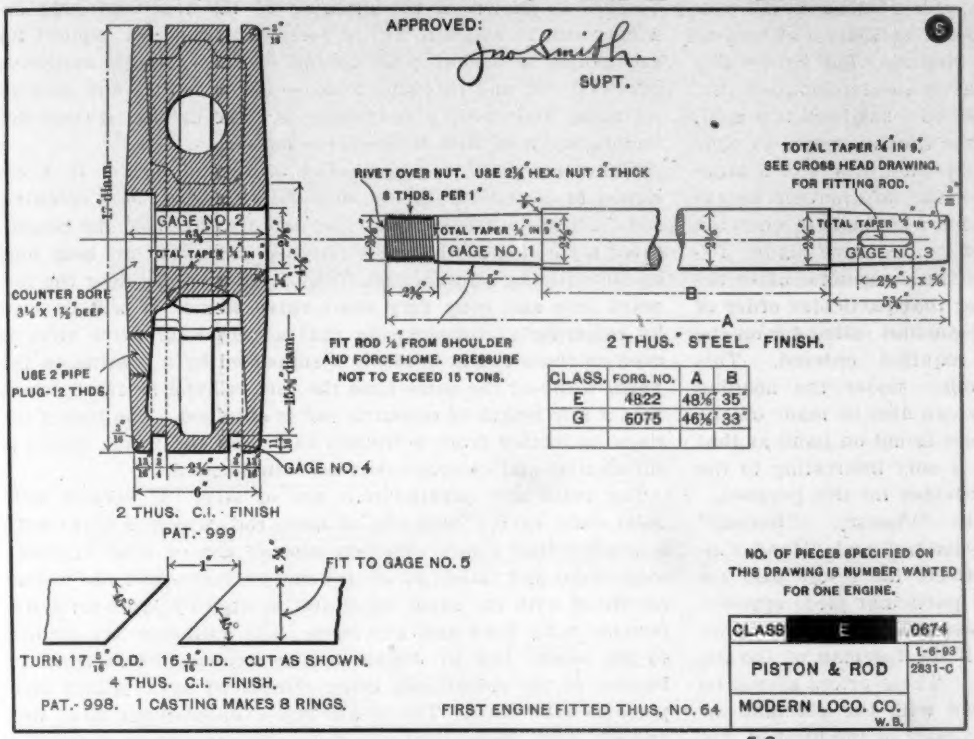


Fig. 1.

Material," "Pattern Number," "Drawing Number," "Requisition Number," "Where From," "Ordered On," etc., are important. In the case of the storehouse, similar headings, with "Price Per Unit," "Total Cost," "How Received" and "When Added" are particularly useful. In the case of the shops the "Number of Pieces," "Pattern Number," "Name of Casting or Forging" or "Number of Forging," "Weight Rough" and "Weight Finished," "Drawing Number," "Planing," "Boring," "Slotting," Milling," "Drilling," "Grinding" and "Hand Finish," are useful.

For the purpose of saving an unnecessary amount of writing and the misunderstandings which may occur due to the different names given to the same thing by different people, all of the forgings, bolts and studs required on the engine are numbered; and the various classes of engines may be, if desired, designated by an additional thousand, one class of engine running from 2,000 to 2,999 for its forging numbers and the next class from 3,000 to 3,999, and so on; or symbols may be used to designate separate classes; this being purely a matter of preference, may be decided accordingly. Owing to the fact that it is considered advisable to do all of the bolt and stud work in a separate and distinct department, which will be hereafter described, the bolts and studs required on an order of engines are included on a separate list, which is similar to the lists already described. It will be found that in time enough drawings of bolts and studs as such will accumulate to answer as a stock to draw from, and if these drawings are not designated for any particular class, the bolts and studs indicated by numbers as above referred to, it will be necessary merely to make a selection of the proper size and specify it on a list intended for one particular class of engine. A complete set of these lists is made out for each class of engine and the class of engine marked on the tracing. It has been found advisable to follow this plan for the purpose of avoiding confusion and the ordering of extra parts, although it may be the case that a list for one class of engine and a list for another class will be exactly similar excepting a few parts. The fact, however, of each one of these lists for the different classes of engines being separately designated prevents confusion, and it will be obvious that a large number of standard drawings becomes a species of stock to draw from, and that any drawing, although for an entirely different class of engine, can be specified on a list for a different class of engine.

For the purpose of keeping record of the scrap per engine as a result of machine work, the columns "Weight Rough" and "Weight Finished" are provided, and according to the work done in each department, this information will be filled in by that department on the respective lists. At the completion of the order of engines all of the lists in the various departments are returned to the office, and the difference between the totals of these two will give the amount of scrap. In the case of the storehouse the price per unit and the total cost is entered from time to time under those respective headings, and at the completion of the order the storehouse lists are returned to the accounting department to be used in making up costs. On each set of complete lists before being issued to the different departments is placed the work order number to which

No. of pcs. per eng.	No. of pcs. ordered.	Kind of material.	Forg. No.	Name of forging.	Drawing No.	Schedule.	Ord'r'd on.	Req. No.	Where from.	How received.	When received.	Forging.	Sawing.	Planing.	Turning.	Boring.	Slotting.	Milling.	Drilling.	Grinding.	Hand finish.	Wt. rgh.	Wt. fin.	Price per unit.	Total cost.
2	10	W. I.	3,006	Main frames.	284	A-1	S				3, 6, '93	141.00		4.00			8.50		3.25			1,201	912	.01	168.76
2	10	Steel	3,007	" rods.	396	C 1	S	376-A	A B. & Co.	Frt. hurried	4, 1, '93	5.50		1.90	1.00		4.50	5.80	3.00	.75	10.90	352	119	1.2	57.57

Remarks: See Bloom Steel Req. 376—A. List .0352.

Approved: JOHN SMITH, Supt. | S

Order for | 10 | eng's.

Work order | 246

Issued | 1-7-'92

Class | D | .0441

Forging list. | 1-3 '92

Modern Loco. Co.

Fig. 3.—(There should be about 35 horizontal blank lines in this form.)

all work done and material used is to be charged for the information of the heads of departments. It will be obvious that any other information which it may be advisable to have may be inserted on these lists at this time. The lists in the general office at their completion will contain all of the order numbers and such other data and information as directly pertains to the ordering of material and the record of its ordering, and at the completion of the order the lists which belong to the general office are filed with this information on them and become a record of that particular order of engines. The lists which have been returned from the shop, after the information concerning weight rough, weight finished, etc., has been taken off, may be destroyed. It will be obvious that in course of time and because of the construction on repeated orders of a large number of the same class of engines the information weight rough and weight finished may become a permanent entry on the tracings of the lists from which prints were made. Before orders for material are made out in the general office the stock on hand which may be used for that particular order of engines is carefully checked with the amount called for on the lists and the difference or what is required ordered. This amount is entered by the general office under the heading "Number of Pieces Ordered." Entry can also be made on the face of the list of the number of pieces found on hand at that particular date; as this information is only interesting to the general office, no special column is provided for this purpose.

The columns headed respectively "Planing," "Boring," "Slotting," "Milling," "Drilling," "Grinding" and "Hand Finish" are intended to indicate respectively the prices paid for each one of those operations on that particular piece opposite to which the price is placed, and those prices are filled in by the drawing room in connection with the foreman of the department in which that work is done. These prices should be the result of very careful consultation with the foreman of that department and a complete knowledge of the limit of his facilities. Enough has been written concerning the establishing of piece work prices to make it unnecessary to comment on the method which can be followed in this case. Suffice it to say that we consider that all of the operations indicated in the headings on the list can be distinctly determined on a strictly mechanical basis and according to the capacity of the machine, and that planing and slotting can be paid for on a basis of so much per square inch, drilling on a certain included range of diameters of holes per one inch of depth, and the other operations in similar manner.

(To be continued.)

TEN-WHEEL PASSENGER LOCOMOTIVE—SOUTHERN RAILWAY.

The Richmond Locomotive Works have just completed and delivered to the Southern Railway two large and heavy simple passenger locomotives. These engines are of the ten-wheeled type and weigh about 158,000 pounds in working order. The general appearance of the engines is seen from the illustration reproduced from a photograph kindly sent us by the builders. We are also indebted to them for drawings of special features herewith shown.

The engines are from designs of Mr. W. H. Thomas, Superintendent of Motive Power of the Southern Railway, and are the result of careful study of the needs of the heavy service required for the "Southwestern Limited," which is a heavy and fast train, and owing to the very long and heavy grades on portions of the run, the necessity for engines that will make fast time up hill was felt. Recent trials of these engines were very satisfactory.

The boilers are of the extended wagon-top type, with radial stays and fireboxes over the frames, the working pressure being 200 pounds per square inch. The heating surface is 2,410.17 square feet, and the grate area 34.9, the ratio being 69.5 to one. This is a very ample heating surface. The cylinders are 21 by 26 inches, the driving wheels 72 inches over the tires, and the driving journals are 8½ by 11 inches, running in solid bronze driving boxes. The eccentric straps are also of bronze. The driving and engine truck axles and crank pins are of steel. The swing hangers for the engine truck are arranged in such a way as to make use of the hangers on both sides of the truck to resist the side motion on curves, and to tend to return the truck to its normal position after passing the curve. This feature is shown in the drawing of the truck hanging arrangement, in which it will be seen that the upper support for the hanger is on two pins instead of one. Ample motion is provided for, and this plan is expected to reduce and prevent swinging and "nosing" on tangents. The driving springs are underhung with rods through the boxes.

The valve gear is also worthy of special notice; it is designed to dispense with the very objectionable "long eccentric rods" formerly used in this type, and also to avoid the complicated style of gear that was designed to replace the long rods by substituting an intermediate or motion bar to clear the forward axle and usng very short valve stems. It will be seen by referring to the drawing that a very long valve stem is used on these engines, which is supported by a bearing on the yoke, while at the same time the link is hung so far forward that a fair length of eccentric rod is obtained. The rocker derives its motion from a "return bar," and the whole device is substantial and compact, but not complicated.

The main and parallel rods are of steel "I" section with solid ends, except back end of main rod, which is fitted with a triple-bolted strap. The crossheads are of steel castings, made solid and tinned on all bearing surfaces, and the pistons are fitted with the usual taper and secured by jamb nuts, dispensing with keys and key slots. The cylinders are secured to the smoke box by double bolting around the flanges, the bottom of the smoke box being reinforced by a ⅝-inch steel plate to take bolts. The steam and exhaust pipes have four and six bolts, respectively, at the joints, and every precaution has been taken to prevent the working or moving of parts from lack of proper fastenings, or poor workmanship in fitting. Owing to height of the boiler, a special dome is designed to take the safety valves and whistle. The throttle valve, which is the Southern Railway's standard, is placed in the main dome.

Westinghouse-American equalized brakes are applied to all driving wheels, and Westinghouse automatic brakes to tender wheels. Automatic signaling device, Golmar bell ringer, Leach's sanding device and other modern appliances are used on these engines.

The tender tank is of 4,500 gallons capacity and ample coal space is provided.

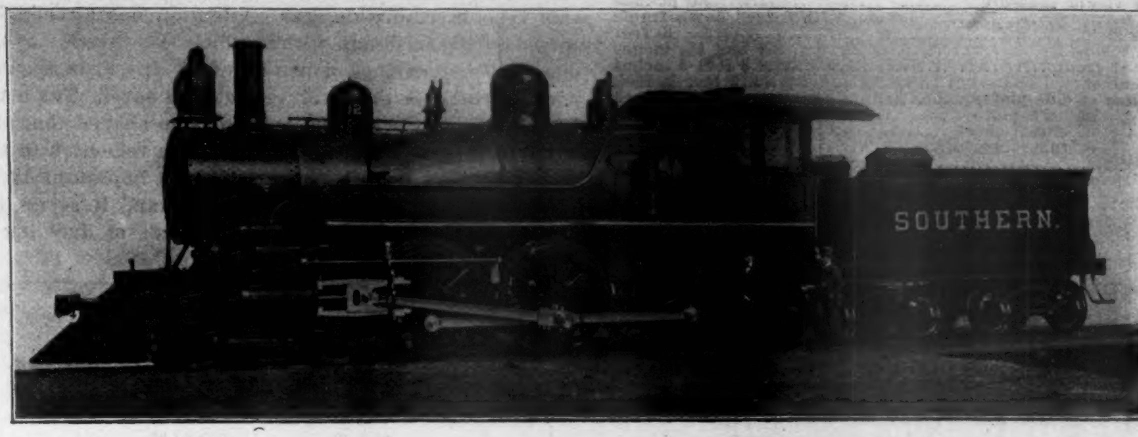
The tender has a heavy steel channel tender frame and Southern Railway standard trucks. The rear of the tender has a Janney-Buhoup three-stem coupling and the pilot has a Janney coupler and Southern Railway standard fastenings. The principal dimensions follow:

General Description.

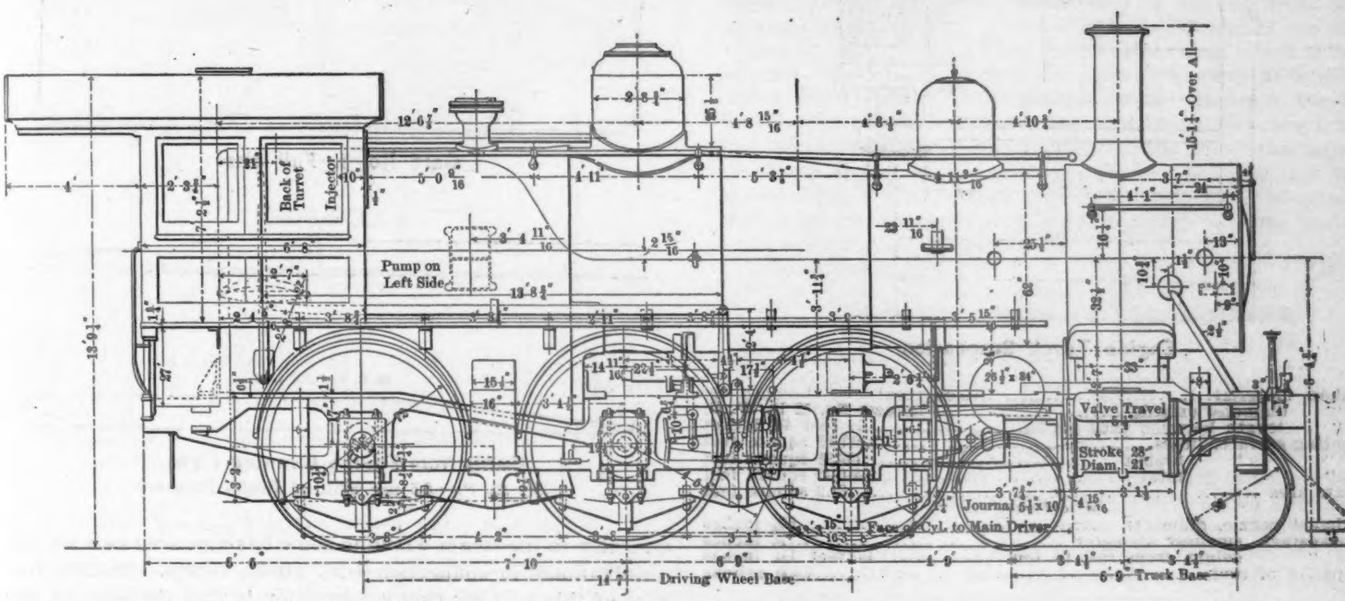
Type of engine	ten-wheel simple
Class of traffic	fast passenger
Gauge	standard
Fuel	bituminous coal

Running Gear.

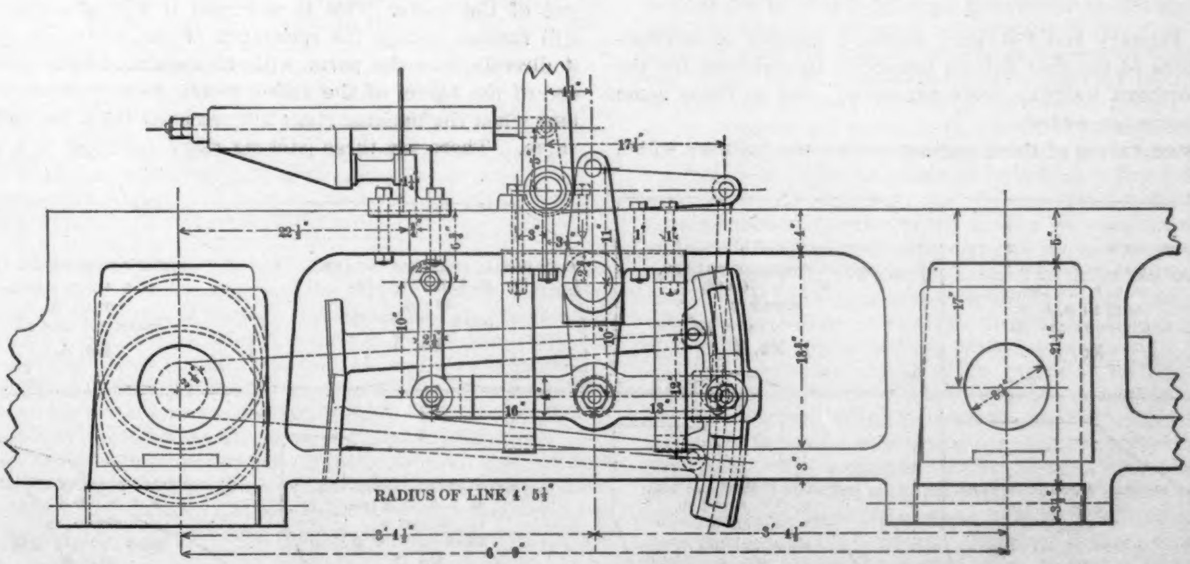
Driving wheels, diameter	72 inches
Truck wheels, diameter	36 inches (McKee Fuller steel tired)
Tender wheels, diameter	38 inches " " " "
Journals, driving axles	8½ by 11 inches
" truck axles	5½ by 10 inches
" tender axles	4¼ by 8 inches
Wheel base, driving	14 feet 7 inches
" " truck	6 feet 9 inches
" " total engine	26 feet 1 inch
" " tender	17 feet 3 inches
Weight in working order, on drivers	121,250 pounds
" " " " on truck wheels	36,750 pounds
" " " " engine, total	158,000 pounds
Cylinders	21 by 28 inches
" distance center to center	87 inches
" piston rod, diameter	3¾ inches
" guides	2-bar type
" connecting rod, length between centers	10 feet 4 inches
Valve gear, type	shifting link motion
Valve ports	length, 19 inches; width steam, 1⅝ inches; width exhaust, 3 inches
Boiler, type	extended wagon-top radial stay
" diameter of barrel inside	60¾ inches
" thickness of barrel plates	⅝ inches
" thickness of smokebox tube plate	½ inch



Ten-Wheel Passenger Locomotive—Southern Railway.



Ten-Wheel Passenger Locomotive—Southern Railway.

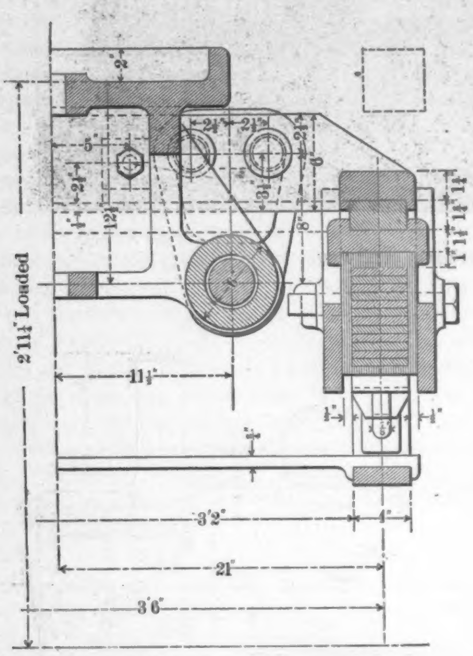


Valve Motion—Showing Connection Between Links and Rockers.

TEN-WHEEL PASSENGER LOCOMOTIVE—SOUTHERN RAILWAY.

W. H. THOMAS, *Superintendent Motive Power.* RICHMOND LOCOMOTIVE & MACHINE WORKS, *Builders.*

Boiler, height from rail to center line....................8 feet 4¾ inches
" length of smokebox.......... ....5 feet 8 3-16 inches
" working steam pressure............ ....200 pounds
Firebox, type........... ....wide, with forged down frame
" length inside ....10 feet
" width inside ....3 feet 5⅞ inches
" depth at front ....6 feet 3 inches
" depth at back ....5 feet ½ inch
" thickness of side plates ....⅜ inch
" " of back plate ....⅜ inch
" " of crown sheet ....⅜ inch
" " of tube sheet ....½ inch
" staybolts.........................1⅛ inch diameter, 4¼ inch pitch
" water space, back and sides... ......3¼ inches; front, 4 inches



Engine Truck Suspension.

Tubes, material.......................... .....charcoal iron, number, 295
" diameter outside ....2 inches; No. 12 B. W. G.
" length between tube plates...................14 feet 4¼ inches
Heating surface, tubes........................ ......2,217.16 square feet
" " firebox ....192.96 square feet
" " total ....2,410.12 square feet
Grate area ....34.9 square feet

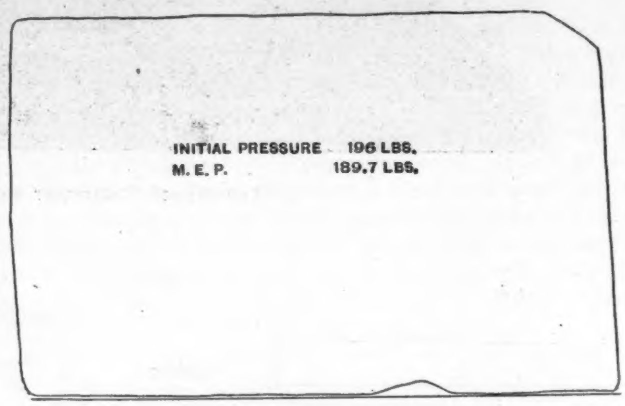
Miscellaneous.

Exhaust nozzle, diameter ....5⅝ inches
Smokestack, smallest diameter ....16 inches
" height from rail to top..................15 feet 1¼ inches
Capacity of tank ....4,500 gallons

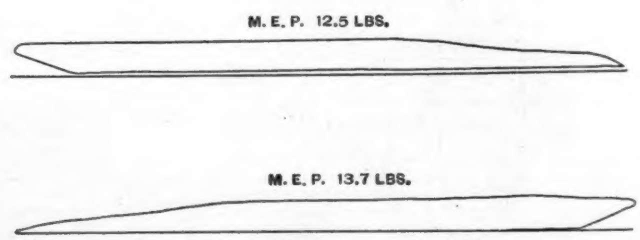
THE GREAT NORTHERN MASTODON LOCOMOTIVES.

In our January and February issues, a number of interesting features of the two Brooks mastodon locomotives for the Great Northern Railway were presented, and to these some further notes are added.

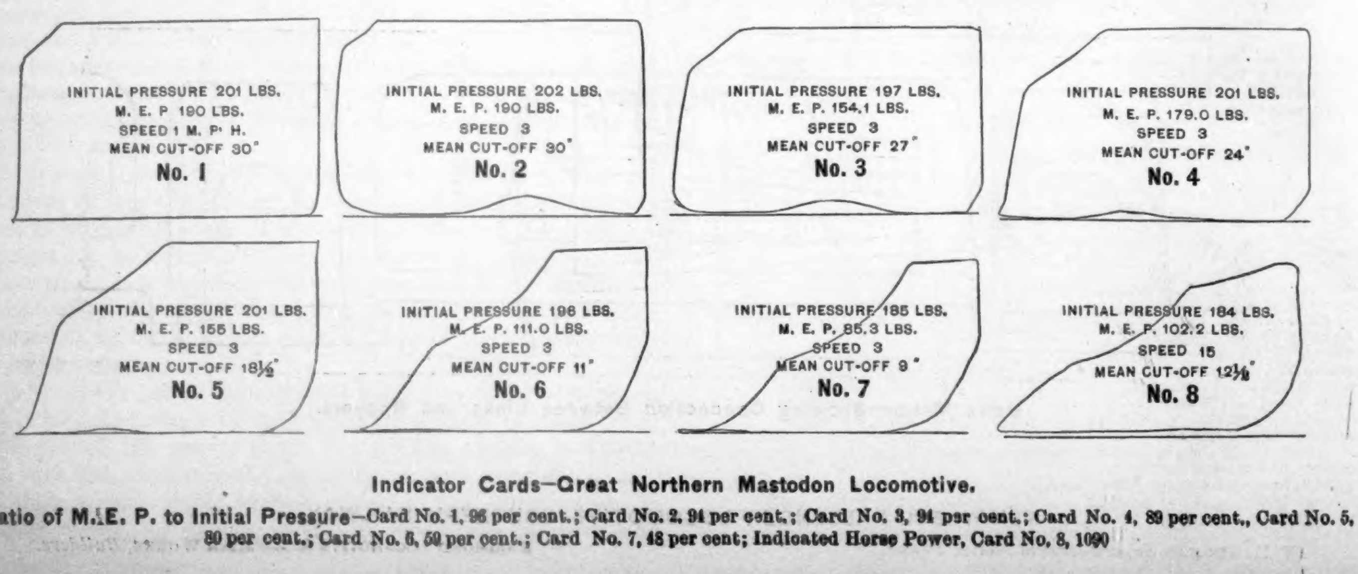
The piston valves of these engines have some features which are worthy of special attention, and they should be examined by those who are considering the employment of valves of this type in future designs. Attention has already been directed to the bushings within which the valves move, and in one of the engravings shown herewith it will be seen that the packing rings for these valves are quite novel. The main packing ring is very wide and thin, it is so shaped that it cannot catch in the ports and for this reason a reduction in the number of bridges may be made. This is important because of its effect upon the passage of steam, and it seems probable that some such plan may be the means of avoiding the obstruction to the steam which to some has appeared as a serious disadvantage in connection with piston valves. Another feature of this packing ring construction is that the edge of the valve which controls the admission of steam is clear of the end of the valve. This is new and it will probably tend to still further reduce the resistance of the steam by admitting it directly into the ports without causing eddies around the end of the barrel of the valve, which must occur to some extent when the packing rings are removed from the ends of the valve. There are three packing rings, each cut in a different



Card No. 1.—Full Size.



Cards from Engine Running Light.
M. E. P. = 6.5 per cent. of Initial Pressure.

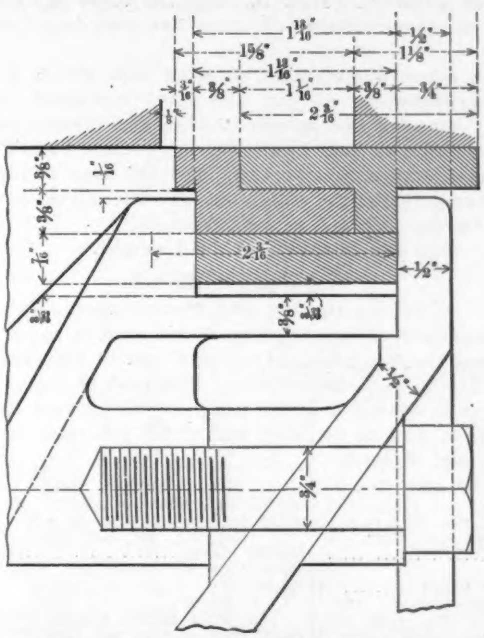


Indicator Cards—Great Northern Mastodon Locomotive.

Ratio of M. E. P. to Initial Pressure—Card No. 1, 96 per cent.; Card No. 2, 94 per cent.; Card No. 3, 94 per cent.; Card No. 4, 89 per cent., Card No. 5, 80 per cent.; Card No. 6, 59 per cent.; Card No. 7, 48 per cent; Indicated Horse Power, Card No. 8, 1090

part of its circumference, and they are fitted together in such a way as to be held in place by a follower.

Some interesting indicator cards, taken from one of these engines, are reproduced in the accompanying engraving. These are undoubtedly larger than were ever taken from a locomotive before. They show the enormous mean effective pressures obtained at slow speeds, and the card taken at 15 miles per hour records 1,090 horse power. Another card, taken with the engine running light and the joint of the throttle valve barely "broken," gives a rough idea of the proportion of power which the engine requires to move itself. The cards were not taken in an elaborate or exhaustive test of the engine, the chief object being to examine the action of the valve gear and to ascertain the mean effective pressures and the power developed by the engine when working slowly at different points of cut off. The card at the speed of 15 miles per hour was taken chiefly to show the effects of the exhaust passages. The largest card was obtained with a liberal supply of sand (the Leach sander is used on these engines), and it was made when pulling a heavy train up a hill. The engine probably will be considered as "over cylindered," according to the generally accepted idea, but it is well to point to the fact that this may be an advantage when the engines are working with a heavy train on a grade because they may then be worked at 50 or 60 per cent. cut off, instead of at full stroke, as would be necessary with smaller cylinders. It is very evident that the enormous weight can all be utilized when starting a heavy train, and also that the power of the cylinders may be rendered available when using liberal quantities of sand.



Section Through Piston Valve Packing.

These cards were taken with a 100-pound spring and under a boiler pressure of 210 pounds per square inch.

There is no more general topic of conversation at this time than the unprecedented destruction of the United States Battleship "Maine" in the harbor of Havana, Cuba, February 15. The ship was launched at the Brooklyn Navy Yard, November 18, 1890, and commissioned September 17, 1895. The cost of the hull and machinery was $2,500,000. Her complement was 37 officers and 343 men. Her length on the water line was 318 feet, beam 57 feet, draft (mean), 21 feet 6 inches, displacement 6,682 tons, and gross tonnage 3,935. Her engines were twin screw vertical, triple expansion type, of 9,293 maximum indicated horse-power and her speed 17.45 knots per hour. She carried four 10 inch and six 6-inch rifles and also seven six-pounder and eight one-pounder rapid fire guns beside four gatling guns.

The Cloud Steel Truck Company, Mr. Willard A. Smith, President, has issued a convenient little pamphlet illustrating and describing the well known Cloud truck and the Bettendorf steel bolsters. Among the advantages urged for this truck are the following. Owing to the use of plate side frames which are flanged upon straight lines repairs may be made without special facilities, the form of the plate passing over the boxes and receiving the pedestal castings upon both sides and being very deep at the inner jaws of the pedestals gives great vertical strength, the use of the wide gusset bracing giving strength against getting "out of square," the use of four easy motion springs or two elliptic springs over the boxes, the small number of parts, the shortness and consequent strength of the pedestal legs and the stiffness of the transoms, which are well braced at the center. The circular states that no trucks can be made with two or more springs over the journal box, in line with the axis of the axle without infringing the patents of the company and that the present capacity of the works, 50 trucks per day, will soon be increased to 100 per day. The offices of the company are 1425 Old Colony Building, Chicago.

Communications.

THE SPEED OF STEAM TURBINES.

Editor "American Engineer":

On page 6, of your issue for January, I noticed a description of De Laval's high pressure steam boiler, which is operating under a pressure of 1,700 pounds per square inch at the Stockholm Exposition, and in reading this article it occurred to me that it would be interesting to know what the speed of the turbine is when used for such high pressures. In the steam turbine, the steam is allowed to expand from boiler pressure to atmospheric pressure and the velocity of the steam would of course depend upon the pressure from which it is expanded. The steam turbine can only be economical when the speed of its rotating wheel bears a proper relation to the velocity of the impinging steam, and that being the case I think the higher steam pressure carried on the boiler the faster it would be necessary to run the turbine. I presume this would be modified if the turbines were compounded, but it occurs to me in reading this article that there might be more behind it than appeared on the surface.

Chicago, February 9, 1898. M. H.

TONNAGE RATING OF LOCOMOTIVES.

Editor "American Engineer":

I noticed in your February issue part of an interesting paper on tonnage rating of locomotives, read before a recent meeting of the New York Railroad Club. I am heartily in favor of tonnage rating, and we have had it in force on the road with which I am connected for some years, during which time the results have fully met our expectations. If, however, we had inaugurated the good work by such a series of ratings as, from the paper referred to, appears to be in force on the Columbus, Hocking Valley & Toledo Railroad I should have been skeptical of the results.

The table of ratings credited to that road shows seven different ratings for as many different temperatures of the atmosphere, and furthermore, for each temperature it has four ratings dependent upon the number of months the engine has been out of the shop. This gives twenty-eight different ratings for each engine, and if there were three classes of freight power on a given division, we would have a total of 84 different ratings to be considered by the train dispatcher, yard master and others having to do with the make-up of trains. But the end is not yet. If the division is a long one and divided (for rating) into several sections, each section having its own rating to fit the ruling grades, the ratings become so numerous as to be bewildering. Had we put such a system in force the complications would have been very great, to say the least. Of course, tonnage rating has to be adapted to local conditions, but I doubt if such an extensive table is needed on any road.

If the maximum rating of an engine is its summer rating, there ought to be no occasion to make a smaller rating when the temperature falls between 40 and 30 degrees; nor is it necessary to have a new rating for each 10 degrees the temperature falls. The maximum rating of our engines is, of course, the summer rating, and throughout this entire winter there have not been more than about 20 days when the engines have not hauled summer tonnage. Certainly if there was no snow to buck against, none of our men would expect to have any reduction made in their trains until the temperature had fallen below 20 degrees above zero. I would say in this connection that this condition is not made possible by a summer rating that is smaller than it should be, for our maximum rating is as heavy as the engine can handle and make reasonable time.

Perhaps an equally striking feature of this table of ratings

lies in the fact that after an engine is out of the shop nine months its rating is reduced; that when twelve months out another cut is made, and when fifteen months in service a third reduction of tonnage is considered necessary. Judging from my experience these reductions are not warranted. We have many engines that make over 100,000 miles between shoppings and haul full trains up to the last trip before entering the shops. It will usually require at least two years to make this mileage, but we make no provision at any time in that period for reducing the tonnage assigned to the engine. Furthermore, we have had in the last six months probably thirty cases of engines that have made over 130,000 miles between shoppings, and were hauling full trains to the very last. This is accomplished by doing thorough roundhouse work. We are trying to get large mileage out of our engines between general repairs and think that we ought to get from 80,000 to 100,000, depending upon the class of the engine; but if an engine is not rendering satisfactory service to the operating department, its place is in the shop, and not on the road, and we take it in as soon as possible. If its mileage is small, it will generally be found that the repairs needed to put the engine in condition will not be heavy. Surely it will pay to carry out this policy, and by this means keep up the tonnage rating. It may slightly increase the cost of repairs per engine mile (although I don't think it will), but the cost of repairs per 1,000 ton miles will be less, and that is the only correct basis on which to work, though I am sorry to say that our accounts are not kept on that basis.

It is our practice to have only two or three ratings for an engine on any one part of the road, these ratings being based on the speed the trains are desired to make. The dead freight rating is, of course, the heaviest, as the speed of this class of trains is the slowest. While intended primarily to meet the different speeds required, the different ratings are also used quite frequently to meet the different weather conditions. The plan is simple, and has worked well. PROVO.

February 15, 1898.

STEEL CARS OF LARGE CAPACITY.

One of the most important of railroad transportation subjects of the time is the effect of steel cars of large capacity upon the earning power of the roads, and three articles which appeared in our issues of December, 1897, page 419; January, 1898, page 19, and February, 1898, page 55, present some ideas upon the questions involved.

Recent orders for cars of 100,000 pounds capacity or more show the tendency in this direction, and it is of interest to note the following substantial lots of cars which are being built by the Schoen Pressed Steel Company. These, in addition to the cars built for the Butte, Anaconda & Pacific, and the 1,000 cars for the Pittsburg, Bessemer & Lake Erie, make a remarkably good showing. The new orders are as follows:

Two hundred coal and ore cars, Pennsylvania Company, 110,000 pounds capacity.

Four hundred and fifty coal and ore cars, Pittsburg & Western, 100,000 pounds capacity.

One hundred coal and ore cars, Pittsburg & Lake Erie, 100,000 pounds capacity.

Forty ore cars, Lake Superior & Ishpeming, 100,000 pounds capacity.

All of these cars are self-clearing, and will be built from the plans of Mr. Charles T. Schoen. The diamond pattern of pressed steel truck, which the Schoen Pressed Steel Company manufacture, will be used under all of these cars. The Pennsylvania and Pittsburg & Western cars are to be used for hauling coal to the lakes from Pittsburg and bringing back ore, and are to have journals 5½ by 10, while the others have 5 by 9-inch journals.

These orders, coming only after most careful inquiry and investigation into the merits of the steel car by officials of roads known to be most conservative, practically settles the future of the steel car. None of these cars will weigh over 34,000 pounds, notwithstanding their great carrying capacity, and those for the Lake Superior and Ishpeming only weigh about 30,000 pounds. They are only 22 feet long and are designed especially for the Lake Superior iron ore trade, the hoppers being arranged to unload into pockets at the docks, which are only 12 feet apart.

Mr. Schoen says: "So general has become the inquiry concerning the steel car that we cannot but feel that transportation officials have begun to realize in earnest what a large money saving can be obtained from its use, the gain on account of reduction in dead weight and the saving in cost and maintenance alone being exceptionally great."

The fundamental underlying thought of the designer and the company building these cars was: Is it possible to build a steel structure of this character as cheap per ton carrying capacity as a well-designed modern wooden car? This has been accomplished by the expenditure of a very large amount of money in plant and a very economic design of car in so far as weight and workmanship are concerned. It has been clearly demonstrated that a steel car adapted for hauling fixed car loads or fixed train loads of material can be built entirely of steel as cheaply per ton of carrying capacity as a wooden car of modern design.

The importance of saving of dead weight in cars is a subject that has frequently been commented upon and admits of little or no question. How to show the value of this saving, however, in actual dollars and cents, has been found most difficult.

We give below a statement showing this, which we believe to be approximately correct, and have combined with it a statement showing the saving in cost and maintenance of a modern steel car, as built by the Schoen Pressed Steel Company, as compared with a wooden car. For the sake of easy reference we have divided the statement into two parts, viz:

First. Saving in cost and maintenance.

Second. Gain due to saving of dead weight.

STATEMENT NO. 1.

Saving in Cost and Maintenance.

The comparison of cost between 30-ton wooden car and 50-ton modern steel car includes interest and cost of maintenance for the life of each car respectively. The cost of repairs to the wooden car is averaged at $40 per year throughout its life of, say, 15 years, and of the steel car at $20 per year throughout its life of, say, 30 years.

Wooden Car.		Modern Steel Car.	
Cost, new	$525.00	Cost, new	$810.00
Interest, 15 yrs., at 6 p. c.	472.50	Interest, 30 yrs., at 6 p. c.	1,458.00
Repairs, $40 per year, 15 years	600.00	Repairs, $20 per year, 30 years	600.00
Cost for 15 years	$1,597.50	Cost of steel car for 30 years	$2,868.00
Double this amount and you have the cost of wooden car for 30 years	$3,195.00		
This means a cost of $106.50 per year during the life of the wooden car, or $3.55 cost per year per ton carrying capacity.		This means a cost of $95.60 per year during the life of the steel car, or $1.91 cost per year per ton carrying capacity.	

Difference in cost per year per ton carrying capacity in favor of steel cars, $1.64, which is equal to 46.2 per cent.

If this $1.64 be multiplied by 50 tons—capacity of steel car—it shows a saving per steel car per year of	$82.00
At $82.00 per steel car per year 500 steel cars will save per year	$41,000.00
At $41,000 saved per year 500 steel cars for 30 years will show a total saving of	$1,230,000.00

STATEMENT NO. 2.

Gain Due to Saving of Dead Weight.

Assuming that trainloads of 1,500 tons of paying freight are hauled, and that the wooden car weighs 16½ tons and the steel car 17 tons:

To haul 1,500 tons, 50 wooden cars are required, weighing	825 tons
To haul 1,500 tons, 30 steel cars are required, weighing	510 "
Dead weight saved per trainload in favor of steel cars	315 tons

If 500 steel cars are used, it will give 16 2-3 full trainloads, which, multiplied by 315 (tons of dead weight saved per train), gives 5,250 tons of paying freight gained for each run of the 500 steel cars.

In estimating the actual cost to a railroad company for hauling ore to, and coal from, Pittsburg to the lakes, many difficulties are met with. We have assumed, however, for the purpose of this comparison, a cost of 15 cents per ton in each class of cars:

5,250 tons of paying freight gained for each run of 500 steel cars, at 15c. per ton, equal	$787.50
If the cars make 30 runs per year, this gain is $787.50 by 30, equal	$23,625.00
Thirty round trips (equal to 60 runs one way), per year, $23,625 by 2, equal	$47,250.00
Gain in 30 years, due to saving of dead weight alone, $47,250 by 30, equal	$1,417,500.00

Recapitulation.

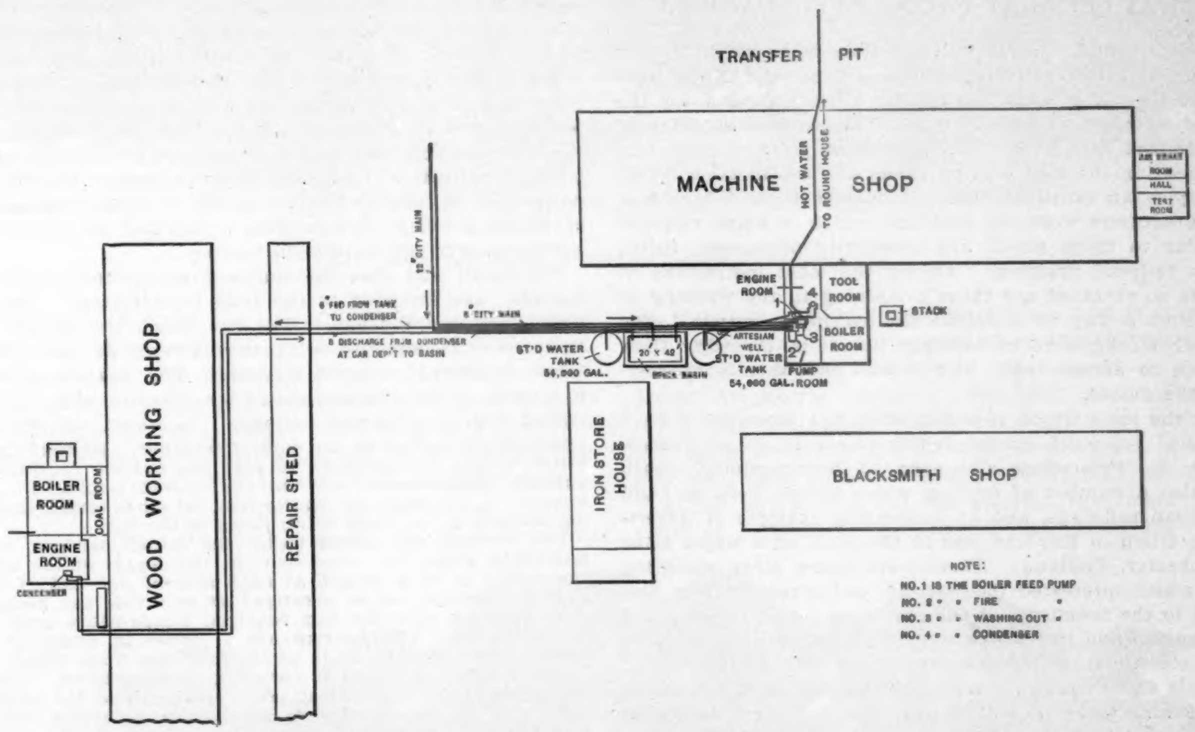
Saving in cost and maintenance, Statement No. 1	$1,230,000.00
Gain due to saving of dead weight alone, Statement No. 2	1,417,500.00
Total saving effected by 500 steel cars in 30 years	$2,647,500.00

CONDENSERS FOR SHOP ENGINES—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

The water supply at railroad shop plants is frequently obtained at considerable expense because of the large amount of water required for the shop engines and for round houses, which are usually located near the shops. Especially is this true where it is necessary to wash out boilers frequently. It is unusual to employ condensers in connection with stationary shop engines and it is believed to be worth while to consider whether some such plan as that in use at the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railway is not applicable elsewhere. This system was devised to save expense and to make use of condensers in connection with two shop engines which are separated by a distance of several hundred feet and at the same time to furnish a supply of hot water for washing out locomotive boilers in the round house.

night for use during the day. These tanks are located very near the well. It is found that with these tanks little city water is required except for purposes for which the artesian water is not suitable. The well delivers about 100,000 gallons of water in the night, which is now saved and used. City water is sometimes needed, and it is admitted to the tanks by an automatic valve, which opens when the tank level reaches a certain point. The storage capacity is also useful in case of fire.

From the storage tanks pipes lead to the condenser in the machine shop engine room and also to the condenser in the planing mill engine room and return pipes deliver the hot water to the large brick reservoir, which is located partially underground and between the two elevated storage tanks. Any overflow from this reservoir is used to flush the sewer. The exhaust steam from the air and water pumps is also utilized to heat the water in the reservoir, the steam being first conducted through a feed water heater to obtain as much



Condensers for Shop Engines–Chicago. Milwaukee & St. Paul Railway.

The essential features of this interesting condenser system are an artesian flowing well, two large storage tanks, a storage reservoir for the hot water, condensers in the machine shop and the planing mill engine rooms—about 300 feet apart—a pump for forcing the hot water into the piping system connected with 22 hydrants in the round house and the necessary piping for the circulation of the condensing water and for leading the discharge from the well into the tanks. The whole system is also connected with the city mains for use in case of any failure of the well, but the chief object of the plant is to supply the condensers and to do the boiler washing with the artesian water, which is not fit for boiler use, in order to save the cost of the city water.

The location of the various buildings may be seen from the accompanying diagram, and the arrangement of the tanks, and the piping system will be understood from the explanation which follows:

The well consists of 1,500 feet of 5-inch pipe; it does not flow sufficiently during the day time to furnish all of the water needed, hence the storage capacity in the form of two large 54,000-gallon tanks was found necessary, and in addition to this the reservoir, which holds 50,000 gallons more, assist in furnishing storage into which the well discharges during the

benefit from its heat as possible. For washing out locomotive boilers in the roundhouse warm water from the reservoir is forced by a special pump into a system of piping, which is cut off from the city mains by a valve, and in case of failure of the hot water system, cold water may be used direct from the mains.

Water for use in the foundry, blacksmith shops and wherever the artesian water may be used is taken from the elevated storage tanks, and a great saving in the use of city water is thereby made.

The question of shop heating is solved without interfering with the use of the condensers by utilizing the exhaust from the air and water pumps for this purpose, the exhaust steam being turned into the storage reservoir when the back pressure increases above two or three pounds. The water in the reservoir is warm at all times, and during the first week in January last it averaged about 110 degrees Fahr. In case the shops should require a great deal of steam for heating, it is of course possible to obtain it by sacrificing at the condensers, but this would be required very seldom, and probably but for a few days at a time. The system seems to be a very good one, and so far it has made it possible to save about 40 per cent. of the former cost of city water. It is reported

to have saved its entire cost of installation during the first year of its use.

The condensers are of the jet type, and were furnished by the E. P. Allis Company, of Milwaukee. They easily maintain a vacuum of about 23 inches, which is equivalent to an addition of the same amount of steam pressure in its effect upon the power of the engines, aside from the fact that the engines now consume less steam than before. It is obvious that in cases where hot water is not required for washing out boilers a cooling tower might be used, and this plan is deservedly growing in favor by those who are unable to obtain sufficient large quantities of water to use condensers without cooling the water. The plant at West Milwaukee was not an expensive one to install and it has much to commend it.

We acknowledge the courtesy of Mr. E. A. Manchester, Assistant Superintendent of Motive Power of the road, for the drawings.

RAILWAY CLUBS AT THE NILES TOOL WORKS.

The Western and Central Railway clubs were recently very pleasantly and instructively entertained by the Niles Tool Works at Hamilton, Ohio, excursions being arranged for the benefit of members of both of these organizations at different times. Judged only from a purely business point of view, this idea of inviting the men who purchase and use metal-working machinery is an excellent one. It enables them to see how the manufacturers work out problems which in many respects are similar to those which are constantly presenting themselves in railroad practice. Among the most instructive of the points so obtained are those pertaining to the working of tools in such a way as to secure the maximum output. The Niles Tool Works were exceedingly liberal in throwing their plant open so unreservedly, and it was undoubtedly appreciated by the guests.

Among the tools which specially attracted attention were a number built to meet special requirements to go to France, Germany, St. Petersburg and even to Johannesburg, South Africa, also a number of driving wheel lathes were in hand for Egyptian railroads, and an interesting example of American competition in England was in the form of a wheel lathe for Manchester, England. There were many other machines in hand which interested the visitors, and attention was also attracted to the foundry and the gun shop. The foundry has a main portion and two wings, and the heavy work is handled by eight electric traveling cranes, the capacity of the largest of which is 60,000 pounds. While the visitors were interested in the machine tools, it is doubtless true that they were even more interested in the work on the twelve-inch rifled mortars and the ten-inch guns and disappearing gun carriages. One of the latter, being set up complete in the machine shop, was exhibited and operated for the benefit of the visitors.

It is certainly a remarkably bold piece of engineering to mount a ten-inch, high-power gun on steel levers, which are long enough to elevate it above the wall or bank that shields it, and at the same time to make the machinery sufficiently strong to withstand the force and shock of the recoil in firing. The parts of these carriages are made with great accuracy, and the Niles Tool Works have been highly complimented on the work which they have done. In order to understand the nicety of the work it should be stated that the elevation of the gun is determined from tables, and it is given the correct elevation when in the lower position; then, when raised to its firing position the machinery must come to a stop at exactly the right point or the angle of elevation would be affected. We are informed that these guns come up to position with an accuracy that is hardly short of perfect. The guns which are being made by this concern are also of special interest, particularly when the exact allowances for the shrinkage of the various hoops and the accuracy required in boring and rifling the barrels are considered. The inspection by the Government officers is very rigid, and the fitting must be so accurate as to require keeping the temperature of the shop uniform which is done both day and night.

The development of these ten-inch guns has been very rapid and satisfactory, and the Niles Tool Works have been closely identified with it. It is worth noting that the rapidity of firing, which is a most important factor in ordnance, has been greatly improved by the work of this concern. Some time ago they guaranteed ten shots per hour (the best foreign record at the time) for ten-inch guns, mounted upon carriages of a different form from these, and the Government offered a premium of $2,000 for every shot in excess of that number that could be made on the trial. The result was a reward of $44,000 for 22 shots above the requirements. We are informed that this is better than has ever been done with guns of this caliber in Europe.

The present order calls for 14 ten-inch guns, eight of which have been completed. The works are very busy, and more men are now employed than at any previous time in the history of the company.

THE GOLD ELECTRIC HEATER—SOUTH SIDE ELEVATED, CHICAGO.

The South Side Elevated Railroad, of Chicago, commonly known as the "Alley L," is being rapidly equipped with the Sprague Electric Company's system of traction, and during the winter the railroad officials sought to determine the advisability of equipping their cars with electric heaters, and in order to satisfy themselves that the adoption of electric heaters would be to their advantage, and at the same time find out which heater of the many offered was the most suitable for the purpose, the road made some very careful and extensive tests of the heaters of five of the most prominent electric heating companies in this country. Each of these companies was given the privilege of equipping a car, and the five cars thus equipped were run during the winter.

The result was that the contract, amounting to about 3,000 heaters, was awarded to the Gold Car Heating Company, of New York and Chicago. The car which the Gold Company equipped was supplied with twenty-four of the improved "Gold Standard" electric heaters. The heaters were wired to permit of six graduations of temperature, which was controlled with a regulating switch. It is stated that its car was comfortably heated in the coldest weather, and that the regulation of the temperature to suit the outside conditions was entirely satisfactory. With the "Gold Standard" electric heaters a satisfactory uniformity of the temperature was maintained at all times in all parts of the car.

The heaters are placed under the seats, eight at each end and eight under the cross seats at the center of the car. The regulation is by a switch at each side of one end of the car, and the circuits are so arranged as to divide the heaters into four sections, whereby any required temperature may be easily obtained. The heaters are 3 inches in diameter and 20 inches long, and are made of steel spirals, upon which enamel is thoroughly baked at a very high temperature. Over this enameled spiral the heating coil is placed, and the ends of the coils and of the spirals are secured to porcelain end pieces, the whole heater being covered by a perforated iron casing. The spirals are non-conducting, and are not affected in any way by the current or the heat. The resistance coils are of a special non-corrosive composition, and in the heaters they are not under tension. A free circulation of air is provided about the coils, which is an exceedingly important item.

As this is one of the largest orders for electric heaters that has ever been placed, the Gold Car Heating Company have reason to be gratified with their success and its recognition.

LECTURES AT PURDUE UNIVERSITY.

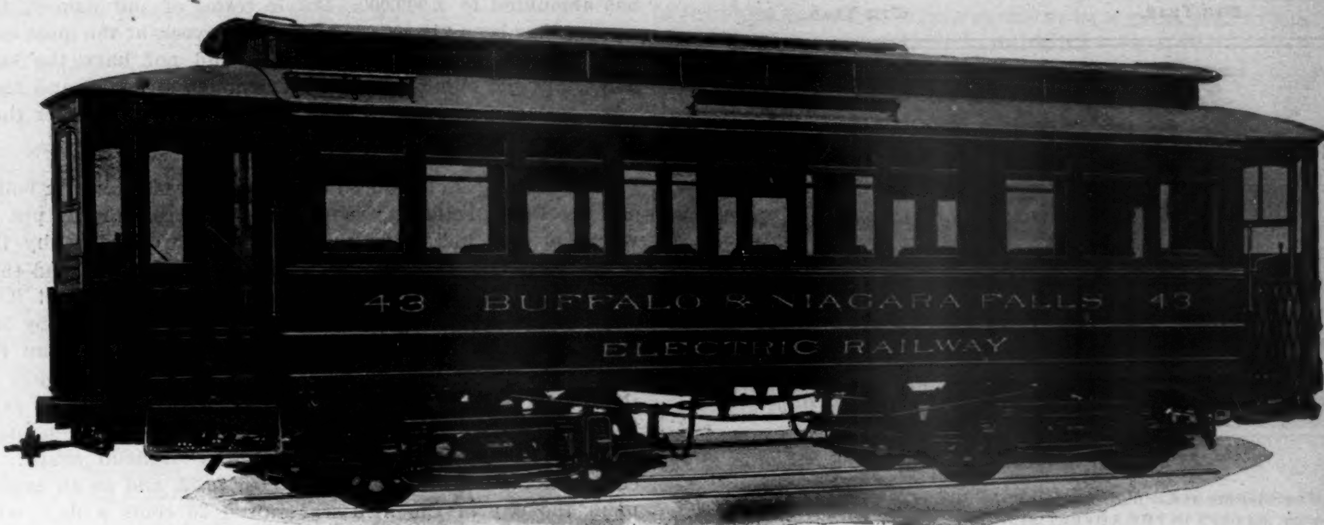
Mr. L. R. Pomeroy, Sales Agent of the Forge Department, Cambria Iron Works, recently treated the senior students in mechanical engineering of Purdue University to an excellent description of the character and significance of the "Coffin Process," as employed by the Cambria Company. The lecture was illustrated by means of charts and diagrams, and was an interesting presentation of the process employed in producing axles, crank pins and similar forgings by that company.

This is in accordance with an excellent plan adopted at Purdue, and also at other colleges, whereby the students are brought into contact with engineers who are recognized as specialists in various lines of practical work. It provides means for broadening the view of students in a way that is impossible otherwise. Men like Mr. Pomeroy are able to give an insight into important subjects with which they are conversant in such a way as to give students an idea of the practical side of engineering work, and it is highly important that they should understand the difficulties of practical engineering and the ways in which they are met commercially. Such glimpses of the work with which they are to be concerned after the completion of courses at technical schools may be made most valuable, and the practice is to be commended and encouraged. This is a plan with which the friends of technical education are in hearty sympathy.

THE "PERFECT" PASSENGER CAR TRUCK.

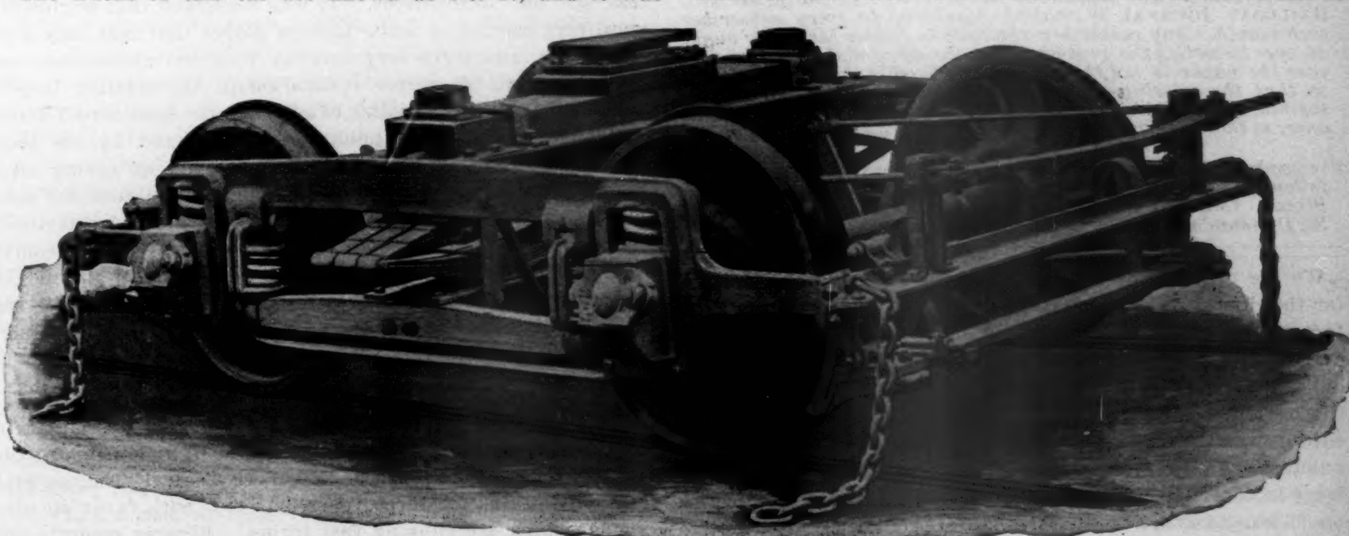
Photographs of a three-spring "Perfect" truck and one of an eight wheel car for the Buffalo & Niagara Falls Electric Railway Company fitted with trucks of a similar design have been received from the builders, the J. G. Brill Company of Philadelphia. The car, which is suitable for city, suburban and interurban service, is 29 feet long and weighs 14,500 pounds, the weight for each truck without motors being 5,100 pounds. It is in use under very severe conditions of service, combining those of the lines in city streets and also those of open country running between Buffalo and Niagara Falls. The peculiar conditions require trucks which, with wheels adapted to city street rails, shall be equally satisfactory under comparatively high speeds while running on T-rails.

The trucks of this car are known as No. 27, and it was upon this road that the first tests of this type were made. In this connection it is interesting to note that in a circular recently issued by J. G. Brill Company a letter from Mr. Burt Van Horn, General Manager of the Buffalo & Niagara Falls Electric Railways, says: "We have a very hard combination of conditions to work against, operating, as we do, an interurban road, the width of the tread and depth of flange being governed by the city rails, and we have yet to record an instance of one of these trucks leaving the rails. In view of our experience with the ordinary center pivotal trucks, this result is remarkable, and we are pleased to say that we know of no safer or better truck in the market."



Brill Cars—Buffalo & Niagara Falls Electric Railway.

In our issue of August, 1896, page 193, we gave several views, together with a description of the truck, and called attention to the special features, which may be summed up as follows: The spring base for this truck is unusually wide, steadying the car and reducing the rolling on the springs; the equalizing bar is carried on springs and is supported by two sets; there are three sets of springs carrying the full load, and they are arranged in what would be termed "in series" in electric parlance. The load is equalized among the wheels and almost all of it is carried upon springs. It will be remembered that the side frames are forgings of the type long ago adopted for locomotive frames. For steam service they are forged, but for electric equipment they are made of cast steel. Our second illustration shows the arrangement of a truck for heavy service, the wheel base of which is 6 feet and the weight of the truck is 7,790 pounds.



Brill Three-Spring Electric Truck, No. 27.

The circular already referred to contains a number of strong letters from railroad officers who are using the trucks, and it is noticeable that the easy riding qualities and the safety against derailment have impressed the authors of the letters. The trucks are used under 50 foot passenger car bodies, weighing 40,000 pounds, and it is stated that although 500 trucks are in operation on 20 railroads, not a single case of derailment has yet been reported. For the reasons for this "adherence" to the track readers are referred to our previous article on the subject.

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Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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We are gratified by the large number of new subscriptions for this journal which are coming in daily, and in spite of the fact that an unusually large edition of the January number and a still larger one for February were printed, we are obliged to apologize to our friends for not being able to supply the present demand for those two numbers. The February edition was the largest we ever printed, and it is now entirely exhausted. We print a much larger edition of the current issue in order to fill the orders for the first paper in the series on "The Construction of a Modern Locomotive" by "Motive Power," and, as the demand will be large, you are urged to subscribe immediately, in order to secure the complete series.

A suggestion with regard to the lubrication of locomotive driving journals is made in another column of this issue, and the importance of the subject renders it attractive to all who have had trouble—and who has not—with the heating of these journals. It will probably present a new idea to many of our readers with regard to the best methods of introducing oil to bearings, which applies to nearly all bearings, whether upon driving journals or not. Even in cases where no trouble by heating has occurred, this method of lubrication has much to recommend it.

The great struggle between the Amalgamated Society of Engineers and their employees, which has been going on in England and has been one of the greatest of industrial contests, has been brought to a close by the withdrawal of the demand for a 48-hour week on the part of the employees. It is estimated by "The Engineer" that this strike has caused a loss in wages of £2,400,000, and that the cash supplied by the unions has amounted to £900,000. Put in terms of our money, the expense has been $12,000,000 to the employees, at the most conservative estimate. The employees did not have the support of public opinion in this tremendous struggle, and they were outlasted by the employers, who are now stronger than ever, while the unions are weaker.

The advantages of induced over forced draft in steam boiler practice find an analogy in efforts to increase the output of workshops by increasing the amount of work done by the employees. It is easier to induce than to drive men, and they may be drawn farther than they may be pushed, but it is not often that the fact is so well pointed out as it was by Mr. L. S. Randolph at the recent meeting of the American Society of Mechanical Engineers. In discussing the subject of the cost of shop operations he related his experience in raising the pay of one of the blacksmiths who had been making a certain forging of irregular and difficult shape. A certain number of them, say 100, cost $6.25, and as an experiment the pay of the men was raised 20 cents a day, with the result of reducing the cost of making the same number to $3.50. This is another example of the sort that may be expected to follow the introduction of piecework, when arranged upon a good plan, and it seems to be a very natural result of a little encouragement.

The advisability of informing locomotive enginemen as to the cost of the various items of supplies that they use was mentioned by Mr. E. T. Jeffery, President of the Denver & Rio Grande Railroad, in an address before the employees of that road. The idea presented was an important one, and it has a bearing upon many branches of the service besides that of the locomotives. It was remarked that enginemen were very careful of white lantern globes that cost only 8 2-3 cents each, and were very careless with red globes that cost 53 cents each. A proper realization of the relative importance of the various supplies handled by the men would doubtless have a good effect upon the returns, and by the great stress that is often laid upon the necessity of saving oil it appears to be possible to over-estimate the importance of some items to the neglect of others that have a much greater bearing upon the earnings. This naturally leads to the conclusion that it would be well to give the standing of the men as regards the use of supplies in terms of the cost of those supplies. This is not a new suggestion, but so far as we know it has not been carried out, except in the cases of wasteful men. It would seem to possess advantages for common use.

The Westinghouse High Speed Brake, which was illustrated and described in our issue of August, 1897, and which at that time had been in use on the New York Central "Empire State Express" trains for three years, has met with favor on other roads, which are running fast trains. Figures recently published show that a train having the ordinary brakes, running at nearly 58 miles per hour, required a space of 1,593 feet in which to stop, while another train, running at 60 miles an hour, and equipped with the high speed brake, required only 1,100 feet. It appears to be very important to make the best possible use of the additional braking power obtainable through the use of the additional pressure that this attachment provides at the first application of the shoes to the wheels and as a matter of 500 feet in the length of a stop generally decides the character and extent of a collision, it may be said that the high-speed feature cannot be put on too soon. It has been applied to the fast trains of the Pennsylvania running between Cleveland and Pittsburgh; on the "Con-

gressional Limited" of the Pennsylvania, between Jersey City and Washington; on the "Black Diamond" of the Lehigh Valley, and the "Empire State Express" of the New York Central. It will be remembered that this high speed brake provides a pressure of 110 pounds per square inch, instead of 70 pounds at the application of the brakes, and that by relief valves, the pressure reduces to the ordinary pressure, as the speed decreases, which prevents the sliding of wheels.

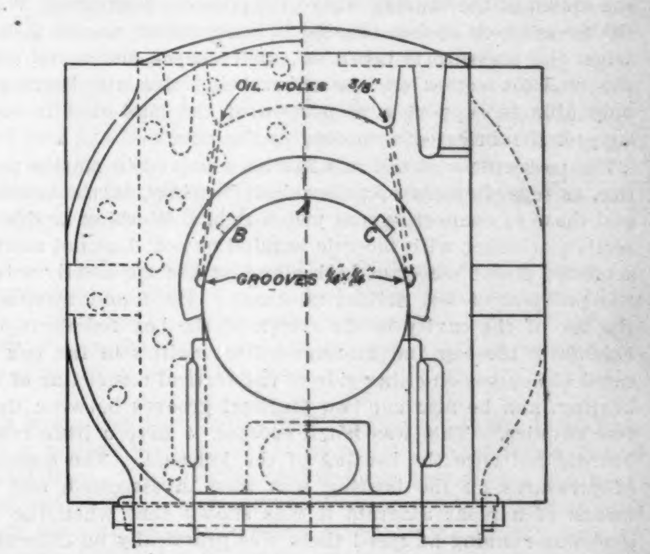
The value of condensers applied to stationary engines and the comparative ease with which the application may be made even when condensing water is expensive and scare, is one of the lessons to be learned from recent electric power station practice. In view of the successful introduction of water cooling towers for cooling water that has passed through condensers, it is surprising that advantage should not more often be taken of this method of increasing the power of existing engines and of improving the efficiency of engines whether new or old. The cooling tower makes it possible for condensers to be used in localities far removed from abundant water supply and in view of the fact that from 15 to 25 per cent. of saving in fuel consumption may be effected by using condensers, it is evident that the subject is worth looking into, in connection with power stations and railroad shops. It is not always necessary to cool the condensing water, for often it may be found advisable to use it hot, as in the case of the Chicago, Milwaukee & St. Paul Railway plant at West Milwaukee, which is described elsewhere in this issue. The chief advantage possessed by this plan is that it may be applied without great expense, and we hope by the presentation of the simple and interesting water and condenser system at West Milwaukee, to show how easily the plan may be worked out and how valuable it is as a money saver. If the hot water is not used for washing out boilers, the problem is yet simpler, as Mr. Louis R. Alberger showed in his paper before the American Society of Mechanical Engineers—printed in volume XVII. of the transactions of that society, page 625. It is believed that this subject is worthy of a great deal more attention than it has received, and that it will be given a more important place in stationary steam engine plants in the future.

The great value of uniformity in naval construction has been urged in these columns, particular stress being laid upon the advantages to be had from duplication and interchangeability in the machinery. It is apparent that in case of accident to an important part of an engine annoying and even disastrous delay may be avoided by the possibility of using a duplicate part carried upon another ship of the same class. There is a much stronger argument for uniformity in design from the standpoint of those who fight the ships, which was admirably expressed by Mr. Charles H. Cramp in a recent lecture on "Mechanism of Modern Naval War" before the Naval War College and published in the "Journal of the United States Naval Institute." He suggested that it did not require the training of a naval tactician to see that a fleet of ten Indianas, compact, handy ships, alike in all leading qualities, would have the ten unequal and diverse battleships of the Mediterranean fleet of Great Britain at an initial disadvantage of tremendous effect, and this without taking advantage of individual superiority. Mr. Cramp believes these considerations to be conclusive against multiplication of types and he believes homogeneity of fleet organization to be of first importance in the use of ships. The effectiveness of a number of ships, all alike, even if they are weak individually, is much greater than that of the same number of ships of unequal ability, even though some of them should be considerably superior to those of the uniform fleet. The uniform fleet could act as a unit the power of which is the ability of one ship multiplied by the number of ships, whereas the fleet of ships of unequal power would be handicapped and limited by the ability of the poorest ship. While it may be true to a certain extent that adherence to applied designs interferes with progress, it is also true that too hasty progress interferes with the best net results and because of the experience of other nations in the direction of diversity in ships we ought to learn the importance of uniformity. Mr. Cramp believes that the first and most important lesson that will be taught by a fight between modern battleships will be the advantage of similarity of type and equality of performance in the ships in action. There seems to be a great deal to support this opinion and nothing to refute it.

LUBRICATION OF DRIVING JOURNALS.

The increasing weight of locomotives introduces many difficulties which will require attention, in order to avoid vexatious troubles on the road. Among these is the heating of the driving journals, which has already given notice that it is to be heard from. The lubrication of locomotives is generally recognized as important, but it is also considered as one of the minor details of operation, and is generally expected to take care of itself. The bearings in locomotive running gear work at all times under the disadvantage of being in an atmosphere of dust and grit until it is surprising that they do not heat much oftener than they do. It is believed however, that the time has come to give more thought to lubrication.

It is not enough to carry oil to a bearing, it must be carried to and between the bearing surfaces, in such a way as to



be sure of staying there. Good lubrication depends upon introducing the lubricant properly and upon the design of the bearing, with such proportions as to avoid squeezing the oil out from between the surfaces. It has been known for years that bearings should not be lubricated upon the side where the pressure or the loading is applied, or rather that when the lubricant enters the bearing on the pressure side the loading cannot be nearly as great as when the lubricant is applied elsewhere, and yet the most common method of oiling a driving journal is at the top of the bearing. In the days of light locomotives and lightly loaded trains the longitudinal oil pocket in the crown of the box, into which the oil was fed from the top of the box, which was packed with waste to hold the oil, was entirely satisfactory, and as long as the journal pressures and piston thrusts were moderate this plan worked very well, but much trouble has followed the continuance of this method of oiling under the changed conditions of work and loading and it seems to be sure to give, to say the least, no less trouble in the future. This leads to the question: Where is the best place for the introduction of the oil into the bearing of a locomotive driving journal?

While others have worked upon the problem of lubrication

of bearings, the experiments of Tower and of Dewrance (for the latter see "Engineering," Vol. LXIII., page 29) should be credited with bringing the subject before engineers in a practical way. Dewrance showed experimentally that the lubricant in a bearing loaded at its top exerted a pressure through a hole in the top of the bearing. He attached a pressure gauge to the hole and found a pressure of oil corresponding to the load put upon the bearing. He further found that when the hole was put beyond the center of the shaft the air in the hole adhered to the shaft and was carried round, leaving a vacuum, and proved this by the gauge. Under favorable conditions he found this vacuum to amount to 30 inches, which was within one-quarter inch of the barometer at the time. He drew this conclusion from his experiments: "That bearing surfaces that are properly lubricated are separated by a film of oil at a pressure per square inch equal to the load that is upon them." The realization of this fact suggested to him the following rule, which may be applied to nearly all classes of bearings:

"Introduce the oil at the points of least pressure, and do not provide a means for escape for it at the points of greatest pressure."

Mr. Dewrance further says: "It is very easy to find out these points of an ordinary bearing that are least subject to pressure, and the oil can generally be brought there with a little scheming. The means of escape most generally met with are oil holes and channels that frequently occur just at the crown of the bearing where the pressure is greatest. When the pressure on such a bearing is intermittent, the oil goes in when the pressure is taken off, and escapes out again when the pressure comes on, the effect being that the bearing is only able to support a proportion of the load that it could support if lubricated according to the rule."

The correctness of the rule has been proved in marine practice, as regards main propeller shaft bearings, thrust bearings and those of connecting and piston rods. Working in this direction, whether with the rule in mind or not, does not matter, a motive power officer of high standing has apparently solved the problem of hot driving journals. He found trouble in the use of the cavity in the crown of the box fed through a hole from the top and first tried two cavities in the box located 45 degrees on either side of the vertical center line of the bearing, and he also cut two diagonal grooves between these two cavities. This was not a success, it gave a little relief, but did not cure the heating of the journals. The question of pressures on the bearing was then investigated, and by means of a polar diagram it was shown that when the engine was running at speed there was practically no difference in the radial pressures at the crown of the box and at a point 45 degrees away from it, and that the pressure gradually diminished down to the horizontal center line of the axle. This led to the removal of the cavities in the crown and at the 45 degree points and two narrow and shallow horizontal grooves were cut across the box slightly above the horizontal center line. These grooves were milled into the shell and three-eighth-inch holes were drilled down into the grooves from the oil cavity in the top of the box and the oil fed directly to the grooves. The drawing shows what was done. First the cavity was at "A," the crown of the box, then cavities were cut at "B" and "C" and finally the grooves and oil holes were tried, as shown, and the trouble from heating was overcome. It was also found that these grooves did not wear smaller as the greatest wear came between "B" and "C."

This plan was tried on one of the journals of an engine that had given a great deal of trouble from hot bearings and after a single run as a helper up a heavy grade the engine was sent out on a through train with no trouble from the box. A second bearing in the same engine was afterward replaced in the same way and this time no trouble was taken to break the box in on a slow run, the engine being returned to its through run immediately.

The plan seems to be a success practically, which is satisfactorily accounted for by the experiments of Dewrance. The proper lubrication of a bearing is worth while; it saves repairs and reduces friction; it saves wear, as was shown by Mr. Alfred Morcum, in his paper, before the Institution of Mechanical Engineers, at Birmingham (England), in which he told of a 300-horse power two-cylinder compound stationary engine, that had been working continuously for four years, at 10.5 hours per day, and when taken down for adjustment, it was found to be absolutely unworn, as far as the bearings were concerned. This engine worked under a system of forced lubrication. In a discussion of this paper, it was stated that by reason of employing this system of forced lubrication engines were often run an entire year, stopping only once for cleaning. These are mentioned with the purpose of calling attention to the advantages which have been made and their practical value in connection with high speed stationary engines. B.

NOTES.

The subject of the adoption of nickel steel for marine boilers has attracted a good deal of attention during the past twelve months. Messrs. W. Beardmore & Co., Glasgow, says the "Mechanical World," have just completed the plates for the first boiler in that metal, to be fitted on board a vessel now building on the Clyde. They are also executing at present several orders for propeller shafts for yachts in that alloy, the greatly increased strength and superior qualities of nickel steel specially commending it for that purpose.

It has been practically decided that the immense electric beacon, built by Henri Lepaut, of Paris, and exhibited at the World's Fair and at Atlanta and Nashville, is to be erected at Navesink Highlands, near Sandy Hook, on the coast of New Jersey. It has been undergoing an elaborate series of tests at the headquarters of the Third Lighthouse District, at Tompkinsville, Staten Island. The theoretical range of this light is 146.9 nautical miles and its candle power is given as ninety million. It has two lenses each nine feet in diameter.

In the mercantile marine, it is beyond question, says "The Engineer," that pressures are rising. The limit has been for the time attained by the Inchmona, whose five-cylinder engines work with 250 pounds of steam. A good deal of criticism has been expended on Mr. Mudd's engines, but they have accomplished all that he promised; at all events, that is the opinion of the owners, who have recently handed over to the directors of the Central Engine Works, West Hartlepool, the large balance which was held over conditionally until a year's working had proved that the engine would satisfy the guarantee. The owners have paid on the basis of a consumption of only 1.15 pound of coal per horse power per hour—an economy which has not, we believe, ever before been attained at sea over twelve months.

In "Scotch" boiler engineering some remarkable advances have been made, says "The Engineer," in reviewing the progress made in marine engineering in the year 1897. A few weeks since Mr. Mudd did a new thing. He has made Scotch boilers ten feet long, and of large diameter, with the shell made of two plates only, flanged at the ends, and riveted to flat end plates. There are two longitudinal straps the whole length of the boiler. After these plates have been bent and flanged, they are placed in a great annealing furnace to do away with local strain. There are no rivets at all under the boiler. Very heavy plant and very big plates are needed, but the boiler thus made is a magnificent piece of work.

That block signals do not necessarily retard traffic and that when carefully arranged and well installed they expedite it, was shown by Mr. Henry Miller, assistant superintendent, St. Louis, Keokuk & Northwestern Railway before the St. Louis Railway Club, when he said that "enginemen can run at speed with safety, relying upon the indication of the signals as against the uncertainty and fear of running into some unprotected

train. We have found that, instead of retarding the movement of traffic, it very materially expedites it. During last December, when our business was very heavy and train movements averaged 100 a day, there was but a single failure."

A strong indorsement of manual block signals was recently offered by Mr. H. D. Judson, before the St. Louis Railway Club, when he said: "The Burlington road about eight years ago, after a very troublesome and costly experience with a heavy traffic, installed on its line for 37 miles west of Chicago the manual block. It consists simply of semaphore blades placed on masts, an average of two miles apart, and operated by a man in a tower. We move over this portion of the road as high as 225 trains a day, or an average of at least 150 a day the year round. The movement of 150 trains means 300 signal movements at each block, 5,700 signal movements every day, or 2,080,500 signal movements a year. Since the installation of the block we have never had an accident for which the block could be held responsible, or one which any block at present in use would have averted. Delays are very infrequent, and if a train ever, during all that time, made a wrong movement, caused by a wrong signal movement, the fact has not come to my knowledge. We do not claim that it is a perfect signal, but we feel pleased with the record we have made with it. Over 2,000,000 signal movements a year intrusted to human hands, without a serious mistake, speaks volumes for the faithful manner in which it has been operated by the signalmen and observed by the enginemen. During the eight years we have used this block we have moved a grand total of considerably over half a million trains. The operation of the block has cost us, approximately, $75,000, or about 14 cents a train, so that we have insured the safe passage of trains over a congested portion of the road for less than one-half a cent a mile.

The report of the Commissioner of Patents states that in 1896 there were received 42,077 applications for patents, 1,828 applications for designs, 77 applications for re-issues, 2,271 caveats, 2,005 applications for registration of trade-marks, 59 applications for registration of labels, and 36 applications for prints. There were 23,312 patents granted, including designs, 61 patents reissued, 1,813 trade-marks registered, and 1 label and 32 prints. The number of patents which expired was 12,133. In proportion to population more patents were issued to citizens of Connecticut than to those of any other State, one to every 759 inhabitants; and next in order in proportion to population come the District of Columbia, with one to every 1,123; Massachusetts with one to every 1,177; Rhode Island with one to every 1,383; New Jersey with one to every 1,453; New York with one to every 1,545; Colorado with one to every 1,761, and Illinois with one to every 1,874. The States to whose citizens the fewest patents were granted in proportion to the number of inhabitants are South Carolina, one to every 31,976; Mississippi, one to every 27,438; North Carolina, one to every 23,793; Georgia, one to every 14,354; Alabama, one to every 13,880, and Arkansas, one to every 13,430.

The comparative output of six passenger car paint shops on one railroad was stated recently in the "Railroad Car Journal" to show that the greatest output per man occurred in the smallest shops, the explanation being that the oversight in the shops employing more men was deficient. This fact is significant as showing the care in management required to run a large plant successfully, and incidentally it furnishes an argument for piecework.

Locomotive tenders of the American or two truck type were used for the first time in Great Britain by Mr. J. F. McIntosh, Locomotive Superintendent of the Caledonian Railway in the design for 15 new engines, the first of which has just been completed. The engines are to haul main line express trains and the tender capacity is four tons of coal and 4,000 gallons of water.

A great bridge is reported to be projected across the Straits of Shimonoseki in Japan, with the object of uniting the main line of the Kiushiu Railway with that of the Sanyo Railway from Shimonoseki to Hiogo. The straits, at the point referred to, are about one mile in width, and the current through them is very rapid. The bridge, moreover, must be constructed sufficiently high to enable the largest ocean steamers to pass beneath. Thus the undertaking, if successfully carried out, would be one of the greatest engineering feats of its kind. The work will be undertaken and supervised by Japanese engineers exclusively.

A speed of 73 miles per hour is recorded for a locomotive on the Pittsburgh, Cincinnati, Chicago & St. Louis Railway in a recent run with eight heavy cars between Columbus, Ohio, and Xenia, in the same State, a distance of 55 miles, which was covered in 47 minutes. The actual time of the run was 56 minutes, but this included three stops, one crossing slow-down and a delay of four minutes at London, making a total loss of nine minutes. The locomotive was built by the Schenectady Locomotive Works.

A new device for getting rid of snow has been tried by the Boston & Maine, for use at the Union station in Boston and in the yards adjoining. The car rests upon four ordinary wheels, but sets very low. It looks like a long box open at the top and with vent holes in the bottom. Through the center of the interior runs a long pipe with diverging arms and at frequent intervals through its entire length and that of the arms are small holes. When this car is attached to a shifting locomotive the pipe is connected by means of a flexible hose with a live steam coil in the engine. The snow is shoveled into the box and quickly melted, the water running out through the vent holes and down between the ties of the bridge into the river. It is calculated that this car can care for snow faster than 25 men can shovel it.

Bilge keels are finding considerable favor for use upon the transatlantic steamers of several lines, and they are being fitted to old as well as new steamers. The advantages claimed are that they prevent excessive rolling without decreasing the speed of the ships.

A large steel floating dry dock, costing $1,500,000, to be built by a private corporation, is proposed to the House Naval Committee. The dock would be large enough for the heaviest battleships. In return for its use for 100 days of each year the Government is asked to guarantee six per cent. on the investment for 20 years, and in case of war the Government would have the exclusive use of the dock. The plans call for a dock 500 feet long, with a capacity of 15,000 tons, and it is suggested that it be moored near Brooklyn, N. Y.

The armor plate problem seems likely to be solved on a basis of $400 per ton, as the price to be paid for that required on the new battleships Illinois, Wisconsin and Alabama. This price was reported favorably by the Secretary of the Navy last year, and it has just been recommended by a vote of the Senate Naval Committee. The plan of building a government plant does not appear to be likely to proceed further than its present situation—that is, on paper.

The anti-scalping bills have been reported favorably by both committees of Congress. The Senate reported favorably by a vote of seven to three and the House by a vote of fifteen to two. This may be taken as a promising situation and unless some very unexpected difficulty arises the abominable practices of scalpers will be squelched. The evidences of fraud, which have been brought to light chiefly through the energy of Mr. George H. Daniels, general passenger agent of the New York Central, are astonishing and it has been proved that scalping is one of the worst forms of dishonesty with which the railroads have to contend. This movement should

have the support of the people and members of the Senate and House should be reminded of their duty in connection with it. This may not be necessary, but it is a safeguard that costs so little trouble that it ought to be taken.

Some historic iron wire, taken from the Niagara suspension bridge, is described by Mr. Frederick W. Cohen, of the Pennsylvania Steel Company, in the "Engineering Record." This wire was manufactured in Manchester, England, and put into the bridge in 1855 by John A. Roebling. At that time the wires showed an average strength of 1,648 pounds each. On the removal of the cables in 1897 the wires were tested, showing an ultimate of 1,566 pounds per wire, equivalent to 93,960 pounds per square inch, which is 95 per cent. of the original strength. It would appear from these tests that iron wire, when strained well within the ultimate, does not deteriorate with use or age, the possible variations of the testing machine and the personal equations of the men making the tests being enough to account for the difference.

Prizes for working locomotives to their full capacity are offered to the enginemen and firemen of the Central of New Jersey. The men are offered a premium each month for the largest number of tons hauled in freight trains between Mauch Chunk and Jersey City, 115 miles. Each locomotive is rated at a certain number of tons, but enough margin is allowed to permit enginemen to exercise judgment and skill and thereby increase the loads hauled to a degree better than may be absolutely required of them. The prizes are $125 for the crew hauling the greatest loads, $50 to the second best and $25 to the third. The engineman's portion is 60 per cent., the fireman's 40 per cent. and the premiums apply to those who make not less than eight round trips.

The Massachusetts Institute of Technology is to have a new building with five stories and basement, covering 58 by 161 feet. The basement and first floor are to be used chiefly by the mechanical engineering and architectural departments, the second floor by the biological department, the third, fourth and part of the fifth floors by architecture, and the rest of the fifth floor by industrial chemistry. The apparatus in the basement will include a 60-foot canal, 3 feet wide and 4 feet deep, for weir experiments, a 225 horse-power tandem compound engine, a 10-ton ammonia refrigerating plant, and a 150 horse-power Parson's steam turbine and dynamo.

RAPID TRANSIT IN NEW YORK.

Among the suggestions for improving the rapid transit facilities in New York, it is proposed to build a line from a point near the present downtown terminus along West street, to serve the North River ferries, which will connect again with the Sixth and Ninth avenue lines at a point above those ferries. It is also proposed that a line should be carried across the city from the Brooklyn bridge to connect with the Sixth and Ninth avenue lines and with the West street line referred to. Additional tracks on the existing structures are also proposed, for the purpose of handling a large portion of traffic over comparatively long distances, by means of frequent express trains, which could be run on third tracks, using them for downtown travel in rush hours of the morning and for uptown travel in those of the early evening. Another proposition has been offered for the extension of the present lines to the city limits on the east and west sides. The change to electric traction, which has caused considerable discussion, has not been made prominent in the most recent propositions by the Manhattan Company, and it is considered doubtful whether such an expensive change will be made in the immediate future. Such a change would provide means for greatly improving the acceleration of trains, and it would avoid disagreeable features of the present system. One of the most necessary improvements, a change in the lower terminals, has not been discussed as fully as many would like. We believe that it is here that the greatest improvement in handling the enormous traffic can be made. The advantages that would be offered by a loop at the Battery seem to be very great and the saving of delays in switching which could be made would doubtless affect the capacity of all of the lines using that terminus.

EXHIBITS AT THE JUNE CONVENTIONS, 1898.

A circular has just been received from the Standing Committee of Railway Supply Men having in charge the arrangements for exhibits at Saratoga, from which we reprint the following:

"It is the desire of the officers of both the Master Car Builders' and the Master Mechanics' associations that the exhibits of supply houses should be as complete and instructive as possible, and to that end the Standing Committee is making every endeavor to arrange for satisfactory exhibits. The rear verandas and the court at Congress Hall have been placed at the disposal of the committee to be allotted to exhibitors without charge.

"The committee has arranged with the management of Congress Hall to furnish steam from a 65 horse-power boiler, a part of the plant of the hotel. A main pipe will be run overhead through the middle of the court, and connections may be made by exhibitors at convenient locations. Exhibitors desiring power will have to furnish the necessary connections from the main steam pipe and also such engines or motors as may be required.

"The heavy exhibits will be located on the lower veranda (ground floor) and in the open court. In making application for space, exhibitors will confer a favor by stating the nature of their exhibits and whether they desire space under cover or in the open court.

"The committee has received a proposition from Carpenter & Taylor, of Saratoga Springs, for cartage to and from the exhibit grounds at the following rates:

"Single boxes weighing up to 1,000 pounds, 25 cents each way.

"Three to five boxes, not exceeding 2,000 pounds, 50 cents each way.

"For heavy machinery, the cost of cartage may be arranged for by special contract.

"In shipping exhibits, it will be best for the exhibitor to consign the same to himself, care of Congress Hall, Saratoga Springs, N. Y., and if the exhibitor finds it impossible to be on the ground to arrange personally for the transfer from the railway station to the exhibit grounds, a letter of instruction to the secretary of the Standing Committee, care of Congress Hall, Saratoga Springs, N. Y., will serve to have the necessary cartage done, but no unpacking or installation of exhibits will be undertaken by the committee or any of its representatives.

"It is the hope of the committee that the installation of all exhibits will be completed by the evening of Tuesday, June 14th, so that the exhibitors may have the benefit of the full period of the conventions, and that there may be as little noise and confusion as possible on the first day of the Master Car Builders' meeting.

"Applications for space and other information should be addressed to Mr. Hugh M. Wilson, 1660 Monadnock Block, Chicago."

BUSINESS PROBLEMS OF THE MOTIVE POWER DEPARTMENT.

In an exceedingly interesting address delivered by Mr. Robert Quayle, Superintendent of Motive Power of the Chicago & Northwestern Railway, before the engineering students of Purdue University, on January 26 last, a number of important features of motive power work were treated, among which was one on the locomotive considered "as a machine—a tool for a purpose—representing a large investment of capital and costing annually a considerable sum for its operation." The speaker said:

Perhaps I can best illustrate this business problem by a comparison which every motive power official has had to make at some time, in connection with the rating of his engines. The tests that have been made upon the locomotive in the testing laboratory of this university demonstrate that the most economical point of cut-off is between one-quarter and one-third of the stroke. Other tests made on this same plant show that as the locomotive boiler is forced and the rate of combus-

tion increased, the rate of evaporation falls off rapidly. The conclusion is therefore warranted that with a given speed a cut-off later than one-third of the stroke will result in a loss of economy, both in the boiler and the cylinders. Are we, therefore, warranted in endeavoring to operate our locomotives under these conditions of maximum fuel economy? The work of the engine varies so much with the grades that we cannot expect to run at a uniform rate of cut-off, but is it economy to endeavor to give the locomotive such a load that it will average one-quarter to one-third cut-off? Let us look into the question. Suppose ours is a nineteen-inch engine in freight service on a hilly division, and that under a limitation of the average cut-off to one-third, the tonnage which it can haul over the division is six hundred tons, exclusive of its own weight and that of the way car. Let us further assume that if the engine is worked to its utmost capacity on the ruling grades (even if by so doing we must run it for many miles at from one-half to full stroke), we will be able to haul seven hundred and fifty tons. The train and engine crews' wages will amount to about 13.2 cents per mile, or $13.20 per one hundred miles. When hauling the heavier train we are getting 25 per cent. more tonnage over the division for the same cost in wages, and thereby effecting a saving of $3.30 for each hundred miles the seven hundred and fifty tons are hauled. This is a clear gain in operating expenses. Now, let us look at the actual consumption of fuel, and in doing this we must bear in mind that while our nominal weights of trains are six hundred and seven hundred and fifty tons respectively, the real weights (allowing one hundred tons for the engine and tender and fifteen tons for the way car) are seven hundred and fifteen and eight hundred and sixty-five tons, respectively. Evidently the weights of the engine, tender and way car form a fixed quantity in our calculations, and that the heavier the train the less the percentage of the total work of the engine needed to overcome their resistance, and the internal resistance of the engine. Evidently the coal consumption in our comparison should be figured on the basis of the tonnage of the cars and their contents only, for upon this is based the earnings of the train. For the six-hundred-ton train the coal consumption may be taken at, say, seventeen pounds of coal per hundred ton miles, or ten thousand two hundred pounds to haul the train one hundred miles. For the seven-hundred-and-fifty-ton train the consumption per hundred ton miles will be about 1½ pounds less, or, say, 15.5 pounds per hundred ton miles. In other words, the lesser percentage of the total work of the engine expended upon itself, its tender and the way car, more than offsets the increased consumption of coal per indicated horse power. The total consumption for the seven hundred and fifty tons hauled one hundred miles will be about eleven thousand six hundred and twenty-five pounds. Thus, while the total consumption of coal per trip is, of course, greater for the heavier train, the consumption per hundred ton miles is less; consequently, the fuel bill to haul three thousand tons of cars and contents will be less if it is taken over the road in four trains of seven hundred and fifty tons, instead of five trains of six hundred tons. So we have saved money in both wages and fuel per hundred ton miles. But the question is broader still. Evidently fewer engines resulting in a lesser investment are required; furthermore, while the cost of repairs per mile run by the engine may be greater the cost per hundred ton miles of train hauled will be less; again, the fewer engines will mean a smaller investment in roundhouses, shops, machinery, etc., and last, but not least, the operating expenses will be reduced in more ways than train crew wages, and the liability of accident will be lessened by the fewer number of trains. Thus the broader the light in which this question is viewed the greater the economy of working the locomotive beyond the point of maximum economy per indicated horse power.

That this view of this business problem is correct will be acceded to by every motive power official. The situation may appear to you to be paradoxical, particularly, in regard to the item of fuel, but that coal can be saved by loading an engine heavily we have proof of daily. The road with which the writer is connected keeps an individual coal record by which the consumption of coal per hundred ton miles by each engineer is recorded. In a group of men in comparable freight service on one division the best performance in November last was 15.9 pounds per hundred ton miles, the engineer having an average train of 853 tons. The poorest record was 28.7 pounds, but the average train was only 378 tons. Of course there are differences in engines (which was true in this case), but all our coal accounts support the statement that other things being equal the heavier the train the less the consumption per hundred ton miles. The limit to this rule is not reached before the engine is so overloaded that the required time cannot be made; so evident is this to our engineers that they are anxious to haul the heaviest trains of which their engines are capable, as by this means only will their records compare favorably with others in the same class of work.

This same mode of reasoning, by which the work of the engine is viewed by its effect upon the net cost of hauling tonnage rather than its economy in fuel per horse power, must apply to other questions involved in locomotive construction and operation. On this basis the size of locomotives has been constantly increasing and will continue to increase. Anything which adds to the economy of performance but limits the amount of work that can be obtained from the engine, either by reducing the tonnage it can haul per trip or reducing the mileage it can make per year, cannot hope to succeed. If a complicated valve gear would save five or ten per cent. in fuel, but would cause the engine to miss a trip occasionally because of repairs necessary to the mechanism, the loss of the service of the engine to the company in busy seasons would possibly more than offset the saving in fuel. On the other hand, simple, strong and reliable construction of the locomotives, facilities for quickly repairing them, and everything that will add to its useful mileage per year, is worthy of careful study. At the same time the necessity of meeting these conditions does not relieve the motive power official of getting the greatest possible economy out of the locomotive as an engine, after he has met the conditions noted, and if he does his whole duty he will be eager enough, in his attempt to obtain this economy, to satisfy the most enthusiastic student of the steam engine.

Personals.

Mr. Frank B. Drake, General Manager, Cincinnati Northern, has resigned.

Mr. J. A. Edwards has been appointed Master Mechanic of the Rio Grande Southern at Ridgway, Colo.

Mr. E. D. Codman has been elected President of the Fitchburg Railroad. He was formerly Vice-President.

Mr. E. Z. Hermensader has been appointed Assistant Master Mechanic of the Wheeling & Lake Erie, at Norwalk, Ohio.

Mr. T. H. Curtis has been appointed General Manager of the Astoria & Columbia River, with headquarters at Astoria, Ore.

Mr. Harry Conrod has been appointed Assistant Master Mechanic of the Columbus, Hocking Valley & Toledo, at Columbus, Ohio.

Mr. C. G. Vaughn has been appointed Chief Engineer of the New Orleans & Northwestern, with headquarters at Natchez, Miss.

Dr. Louis Duncan, of Baltimore, has been appointed Electrical Engineer of the Third Avenue Railway Company, of New York.

Mr. James Hickey has been appointed Master Mechanic of the Gulf & Interstate Railway, with headquarters at Beaumont, Tex.

Mr. James A. Corey, a locomotive engineer, on the Boston & Maine, has been appointed Master Mechanic of the shops at Portsmouth, N. H.

Mr. James M. Kirk has been appointed Master Mechanic of the Salt Lake & Ogden, with headquarters at Salt Lake City, vice W. T. Godfrey, resigned.

Mr. George Dickson, General Foreman of the St. Paul shops of the Great Northern, has been put in charge of the mechanical department at West Superior.

Mr. George H. Pegram, Chief Engineer of the Union Pacific, has resigned, to accept the position of Consulting Engineer of the Manhattan Elevated of New York.

Mr. A. C. Michaelis has resigned his position as General Manager of the Central Railway of Guatemala, Central America, owing to the revolution in that country.

Mr. W. McLane, late of the Plant System, has accepted the position of Master Mechanic of the Bellingham Bay & British Columbia Railroad, with headquarters at New Whatcom, Wash.

Mr. Edward L. Moser has accepted a position in the engineering department of the Baldwin Locomotive Works; he was formerly Mechanical Engineer of the Philadelphia & Reading.

Mr. C. C. Martin, long known as Chief Engineer and Superintendent of the New York & Brooklyn Bridge, has been ap-

pointed Engineer of Bridges for the Boroughs of Brooklyn and Queens.

Mr. James M. Kirk, formerly with the Chicago, Rock Island & Pacific, has been appointed Master Mechanic of the Salt Lake & Ogden, with headquarters at Salt Lake City, Utah, to succeed Mr. W. T. Godfrey, resigned.

Mr. J. M. Percy, formerly Master Mechanic of the Cincinnati, Hamilton & Dayton, at Cincinnati, Ohio, has been appointed Master Mechanic of the Baltimore & Ohio Southwestern, with headquarters at East St. Louis, Ill.

Charles B. Chester, Master Mechanic of the Guatemala Central Railway, of Central America, died at Chattanooga, Tenn., January 8, at the age of 47 years. He was formerly Master Mechanic of the Chattanooga, Rome & Columbus.

Mr. James M. Percy, formerly Master Mechanic of the Cincinnati, Hamilton & Dayton, at Cincinnati, has been appointed Master Mechanic of the St. Louis division of the Baltimore & Ohio Southwestern, with headquarters at East St. Louis.

Mr. A. D. Allibone has resigned as Purchasing Agent of the Wisconsin Central to take effect February 19, and will be succeeded by Mr. John A. Whaling, who held the position previous to January 1, 1896. Headquarters, Milwaukee, Wis.

According to a communication received from Mr. Robert Andrews, vice-president of the Safety Car Heating and Lighting Company, Mr. W. H. Hooper has been appointed general agent of the company, with office in Chicago, vice Mr. George N. Terry, resigned.

Mr. H. H. Vaughan, formerly Mechanical Engineer of the Great Northern, at St. Paul, has been appointed Mechanical Engineer of the Philadelphia & Reading, at Reading, Pa. Mr. Vaughan is a capable young man, with a good record. He and the officers of the road are to be congratulated.

Mr. J. F. Weed, a Civil Engineer, of Houston, Tex., was appointed February 6, Chief Engineer of the Gulf, Beaumont & Kansas City Railroad, with headquarters at Beaumont, Tex. Mr. Weed was formerly connected with the Land Department of the Southern Pacific and the Houston & Texas Central.

Mr. Samuel Porcher, heretofore Assistant Purchasing Agent of the Pennsylvania Railroad, has been appointed Purchasing Agent to succeed A. W. Sumner, deceased. Mr. Porcher has been in the service of the Pennsylvania since 1882, and has been Assistant Purchasing Agent since 1894. His office is at Philadelphia.

Mr. A. D. Wilder, Division Superintendent of the Southern Pacific, died at Oakland, Cal., February 14, of pneumonia. He was born in Attica, N. Y., July 31, 1843, and entered railway service in May, 1859, as clerk, with the Erie, and had been with the Central and Southern Pacific roads since December, 1868. He was appointed Division Superintendent in December, 1878.

Mr. H. E. Walker has been appointed Locomotive and Car Superintendent of the Interoceanic Railway of Mexico, succeeding Mr. E. V. Sedgwick, resigned. Mr. Walker has been Superintendent of Machinery of the Mexican Southern Railway for nearly seven years, coming from London when the road was commenced. His place will for the present be filled by Master Mechanic W. I. McCammon.

As we go to press reports have been received to the effect that the Brooklyn Elevated Railroad has contracted with the Walker Company, of Cleveland, to equip 150 cars with Walker electric motors, which are to be controlled by the Sprague system of multiple control. This system was adopted with a view of running the cars over the Brooklyn Bridge into New York, and this system of control disposes of the difficult problem of switching the cars at the New York terminal. The work is expected to be completed by June first.

BOOKS AND PAMPHLETS.

"Whittaker's Mechanical Engineer's Pocket-Book." By Philip R. Bjorling. Size, 4 by 6 inches, 377 pages; bound in leather. Illustrated. Published by The Macmillan Company, 66 Fifth avenue, New York. 1898. Price, $1.75.

This book contains 130 tables, in which pumps and hydraulic work are specially well represented; pipes, windmills, gas engines, steam engines, mining machinery, ropes and belting, speeds of machinery and tools wire gauges bolts and nuts, weights of plates and mathematical tables are also included. The book contains much information that is needed by steam engineers and machinery designers, and much more that is valuable in hydraulic work. It is provided with an index and is convenient in size.

"The Monthly Official Railway List," January, 1898. "The Official Railway List," which for 26 years has appeared as an annual publication, and is probably the best known list of railroad officials published in this country, has just added to its usefulness by appearing each month. The first copy under the new plan was received too late to be mentioned in these columns in our February issue. The list includes an alphabetical list of all railroads in operation in the United States, Canada and Mexico, with a list of officers and their addresses, fast freight lines and private car lines and their officers, index of location of general offices and shops of railroads, list of traveling representatives of railroad supply houses, tables and data for use of track department, lists of national and State railroad commissioners, railroad and technical associations and sleeping car and telegraph companies, with their officials. The publication is so well known as to require little at our hands except a statement that it is to be published monthly. This implies an immense amount of labor, which will without doubt be appreciated by those who have occasion to refer to the valuable information contained in the publication.

"Scientific American Supplement Reference Catalogue." This is a volume of 48 pages, bound in cloth, giving an index or catalogue of the valuable papers to be found in the "Scientific American Supplement." It is cross indexed, and the headings are in full-faced type, which contributes largely to its convenience. The list contains references to more than ten thousand of the more important articles, many having been omitted because of lack of space. The great value of this list lies in the fact that many of the subjects have not been treated in books. We are glad to have a copy of the catalogue and expect to find it exceedingly useful. We understand that the catalogue will be sent free upon application, by addressing Munn & Co., 361 Broadway, New York.

"Record of the 'Perfect' Truck, 'Brill No. 27.'" Under this title the J. G. Brill Company, of Philadelphia, has issued an illustrated pamphlet explaining the design and construction of the "Perfect" Truck and giving the reasons for its success. This truck is in use on many lines under the severe conditions imposed by a combination of open road and street railway working and the statement that after two years of service no case of derailment has been reported is abundantly supported. The pamphlet contains a number of remarkable letters from railway men who are using the trucks, one of which is quoted elsewhere in this issue. The letters are convincing of the merits of this truck, and as they come from Presidents, General Managers and Superintendents, the testimony is to be accepted as authoritative in the highest sense. Such remarks as these are found in them: "Does not leave the track," "Forty miles per hour with shallow flanges and narrow treads," "Have tried other trucks, but make 'No. 27' standard," "Are operating only your 'No. 27' truck," "A radical improvement," and "Never had one derailed under any conditions." The trucks are used under heavy as well as light cars, and the records are worthy of examination.

"Brown's Discipline of Railway Employees Without Suspension." This pamphlet, published at Easton, Pa., by the Railway Discipline Publishing Co., price 17 cents, is devoted to the explanation of the system of discipline first introduced by Mr. G. R. Brown, General Superintendent of the Fall Brook Railway. The book contains two articles by Mr. Brown giving a statement of his experience of thirteen years, which are followed by circulars of a large number of railroads that have adopted the system; it also presents private and public letters upon the subject. The book is in convenient form and

operating and mechanical officers of railroads should make a point of reading it.

"Cambria Steel Rails." The Cambria Iron Company, Philadelphia, Pa., whose works are at Johnstown, Pa., has published a volume of illustrations and tables of sections of T rails and their joints, a copy of which has just been received. This is Volume I. and is devoted entirely to T. rails, Volume II. being given to street or girder rails for electric railroad use. In Volume I. are full-sized sections of standard rails in most general use, with all dimensions given, and also the number of tons per mile of track. Accompanying each rail section is the corresponding splice section, and at the end of the book frog fillers, special splice bars and track bolts are illustrated. Tables referring to track bolts and their weight are included. Volume II. also contains sections of T rails, but is chiefly given to the special sections for street and electric use. These sections are also dimensioned and are drawn full size.

"Diamond 'S' Brake Shoe." The Sargent Company, Chicago, has issued an exceedingly handsome illustrated pamphlet, containing a report of tests on the laboratory brake shoe testing machine of the Master Car Builders' Association, on the "Diamond 'S' Brake Shoe." This report was published in abstract in our December issue of last year, page 424. The tests were conducted for the Sargent Company by Mr. J. C. Whitridge, of Chicago. Besides the report, the pamphlet contains comments and notes on service tests. This is one of the most attractive trade pamphlets that we have seen and it is worthy of preservation.

"Air Compressors." The Ingersoll-Sergeant Drill Co. This concern has just sent us a booklet 3½ by 5¼ inches in size, which is a condensed illustrated edition of their catalogue of air compressors. It is a handy little volume that our readers ought to procure, which they may do by asking for it. Compressors in great variety are illustrated by good half tone cuts and on the pages opposite the various illustrations are lists of some of the users of these types.

"The Composite and Its Field," by C. Peter Clark, General Manager New England Railroad, Boston. This is an illustrated paper on the composite locomotive and car, a reprint of the paper read by Mr. Clark before the New England Railroad Club, December 14, 1897, and printed in abstract in our issue of January, current volume, page 29. It is a clear and comprehensive treatment of this interesting subject.

EXPERIMENTAL BALDWIN LOCOMOTIVE AT COLUMBIA UNIVERSITY.

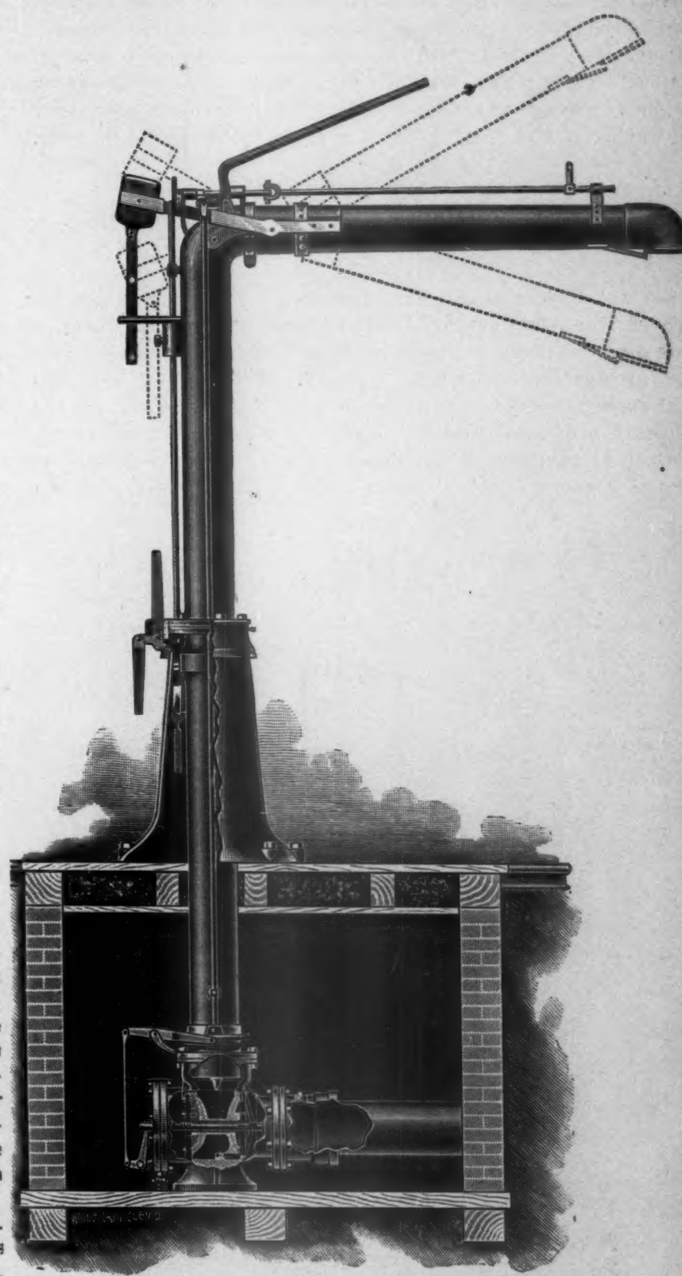
We are informed by Professor F. R. Hutton, Professor of Mechanical Engineering, Columbia University, New York, that the engineering school of that university has just been presented with the locomotive "Columbia" by the Baldwin Locomotive Works. This is the engine that was exhibited at the World's Fair in 1893, and it is expected to be used as a laboratory locomotive on a plan similar to those carried out by Professor Goss at Purdue University, and by the Chicago & Northwestern Railway at its Chicago shops. The liberality of the Baldwin people will be appreciated by all who are interested in the subject of transportation by rail.

The engine is a "Vauclain Compound," designed by Mr. S. M. Vauclain. It is one of a group of exceedingly valuable machines recently given to the mechanical engineering department. C. C. Worthington has presented, in memory of his father, some hydraulic machinery valued at $20,000. Besides pumps of notable capacity, his gift includes accumulators, meters and facilities for measuring the flow of water and the verification of formulas and constants. William W. Allis, of Milwaukee, has also contributed valuable machinery as a memorial to his father.

SHEFFIELD STANDPIPE NO. 6.

A new standpipe or water column has been introduced by the Sheffield Car Company, of Three Rivers, Mich., which is illustrated by the accompanying engraving. The objects toward which these manufacturers have worked in all of their water columns are a spout that may be moved vertically and horizontally, a protection of the column from injury by water hammer, automatic drainage of the column and satisfactory control of the valve, by which the speed of opening and closing may be regulated by the man who operates it.

This new column provides a free passage of water and the valve, being horizontal, admits the water to the vertical column without the obstruction of an extra turn in its course. The mechanism is arranged on the outside of the pipe for easy access. The operating lever is placed convenient to the fireman's hand and the motion required to operate the valve



The Sheffield Improved Standpipe No. 6.

is a very small one. The construction of the valve chamber is such as to permit the removal of the valve entirely by taking off the head of the casing. The cylinder is lined with brass and is not liable to corrosion, and the valve is provided with a rubber seat to secure tightness under all pressures used. The joint in the delivery arm of the pipe is of rubber, specially prepared to resist the action of cold weather. The vertical adjustment accommodates varying heights of tenders, and there is no drip from the end of this pipe to cause icy tracks.

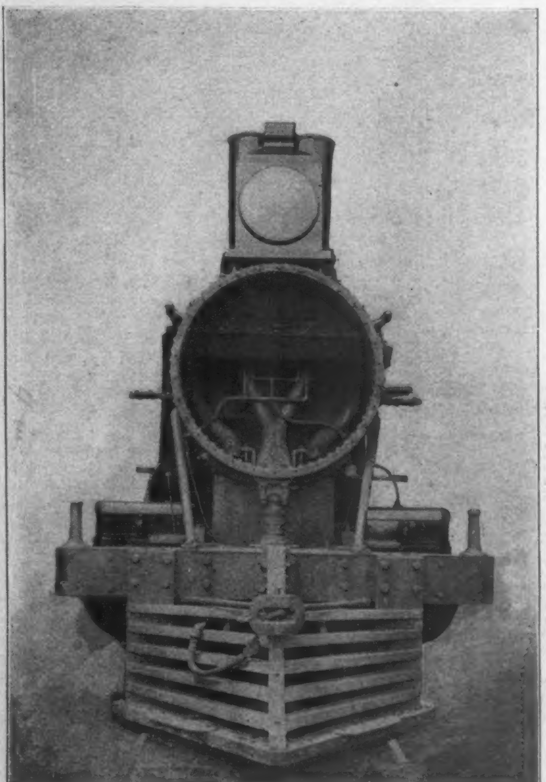
The delivery arm is counterweighted, and the entire weight of the column is carried upon a center bearing at the lower

end of the vertical pipe. A positive lock is provided to secure the pipe in position when it is thrown parallel to the track.

The construction of the main valve is shown in the engraving. It has two disks, one of which is the valve proper, while the other is an hydraulic piston, which is controlled by an operating valve, worked by a rod passing through the center of the main valve and into a guide bar, which is cast in the valve seat. The operating valve controls the passage of water from the main pipe to the hydraulic cylinder, and it also controls the exhaust from that cylinder into the water column, and as the piston is of larger area than the valve, the pressure of the water against it will close the valve and hold it against its seat, while relief from this pressure will allow the valve to open. Sand which may accumulate in the cylinder may be washed out through a small cock provided for the purpose.

DOUBLE STACK LOCOMOTIVES—TOLEDO, PEORIA & WESTERN RAILWAY.

Several devices have been introduced for the purpose of improving the draft arrangements of locomotives and efforts in this direction have not been confined to this country alone, no less an authority than Mr. F. W. Webb, chief mechanical superintendent of the London & Northwestern, having recently produced a design having two exhaust pipes and a horizontal partition across the smoke box. This was done to secure a more equal distribution of draft between the top

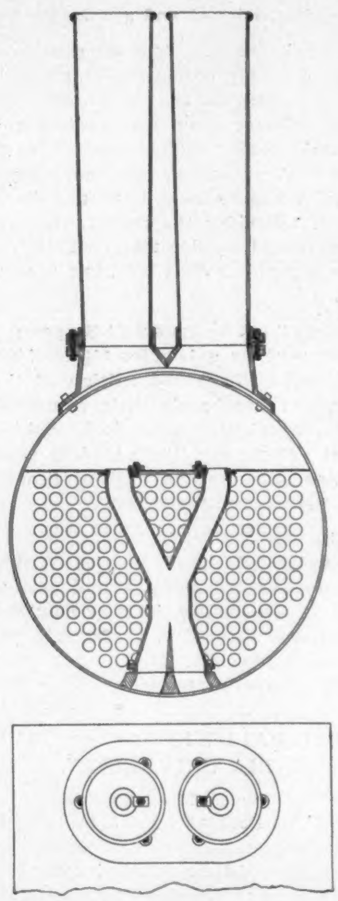


Double Stack Locomotive.

and bottom flues. The device used on the Toledo, Peoria & Western has a similar object, the equalizing of the draft, but there is no partition in the smoke box, and the equal distribution of draft between the center and the outside flues is specially sought in this case.

The engravings illustrate the device as applied to a Rogers locomotive of the consolidation type; they show the stacks to be side by side, instead of in tandem, as in the English engine referred to. The exhaust pipe is double, and of such a form as to lead the exhaust from each cylinder into both stacks. The sectional view shows the form of the exhaust pipe and the arrangement of the netting. The chief claims made for the arrangement are, the production of an even draft through all of the tubes; an increase in size of exhaust nozzles over other practice, a saving of wear on boiler flues, and a saving of fuel.

The device has been tried for several years on the Toledo, Peoria & Western Railway, and also on the St. Louis, Chicago & St. Paul, good records having been made on both lines. In July and August, 1896, tests were made on regular passenger trains on the Toledo, Peoria & Western, the engines having 16 by 24-inch cylinders, and making two round trips on the Western division, from Peoria to Keokuk, 113 miles. The engines were in equally good condition and differed only as to the draft appliances. They both made the same number of



Double Stack Locomotive.

stops, 25 in 100 miles run. Other comparisons were made on five 16 by 24-inch passenger engines, three with double stacks and two with ordinary stacks, each making two round trips on the Eastern division, from Peoria to Effner, 111 miles. All the engines were in equally good condition and all made the same number of stops. The records are as follows:

WESTERN DIVISION—PEORIA TO KEOKUK.

	Average double stack.	Average single stack.	Percentage favor double stack.
Ton miles per train per trip....	16,950	16,950	0
Aver. speed in miles per hour..	33.50	32.60	3 per ct.
Pounds water evaporated per pound of coal	5.50	5.00	10 per ct.
Miles run per ton of coal.......	55.80	50.60	11 per ct.
Pounds coal to haul 1 ton 1 mile	.239	.259	8 per ct.

EASTERN DIVISION—PEORIA TO EFFNER.

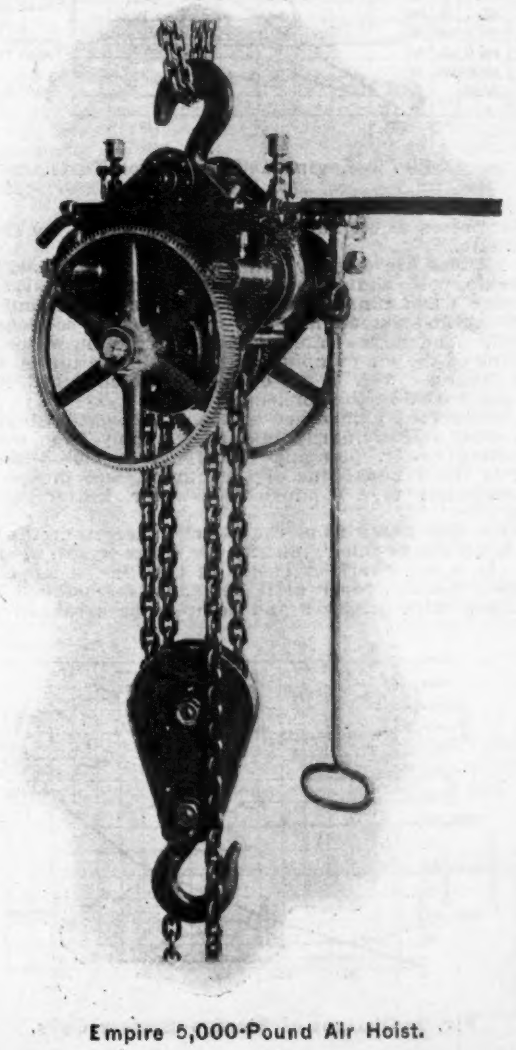
	Average double stack.	Average single stack.	Percentage favor double stack.
Ton miles per train per trip....	16,474	16,420	33 per ct.
Aver. speed in miles per hour..	40.80	40.60	50 per ct.
Pounds water evaporated per pound of coal....................	5.00	4.60	9 per ct.
Miles run per ton of coal.......	39.20	35.80	11 per ct.
Pounds coal to haul 1 ton 1 mile	.345	.372	8 per ct.

Mr. W. B. Warren, general foreman of the Toledo, Peoria & Western Railroad, designed and patented this arrangement, and we are indebted to him for the photographs and results

THE EMPIRE AIR HOIST.

This air hoist is an application of two rotary air motors to a differential chain hoist and has the well-known advantages of the chain hoist. The motors are about two horse-power each, they are reversible and are fitted between the two side plates that form the frame of the hoist. Pinions on the ends of the motor shafts mesh directly with large driving gear wheels, which operate the hoist by means of two differential chain wheels. The whole device, when built for a capacity of 5,000 pounds, occupies a space 42 inches high, 21 inches wide and 15½ inches deep when the hook is drawn up. The total weight is 241 pounds, and that of a single motor is 29½ pounds.

The motors are most carefully made and their design is such as to meet many of the objections which have been raised to



Empire 5,000-Pound Air Hoist.

the rotary type. The wings are not set out by springs, but by a positive adjustment, as they are of phosphor bronze, as hard as can be made, and ground accurately to fit the casing; good wearing qualities may be expected and the remarkably small number of parts should contribute to this desideratum. The construction is done on jigs for the sake of interchangeability, such care being given to this feature as to lead the manufacturers to urge this as a claim for superiority.

The hoist has advantages over those in most common use, in that it occupies little head room and is adjustable to an indefinite extent as regards length of lift, a lift of ten feet being ordinarily provided for. Like a chain hoist, it will hold its load and it does this without strain on the motors, and the control of the motors is such that accurate lifting in handling machinery in lathes or other tools may be had. Air hoists have contributed very materially to the cheapening of mechanical operations in shops and the progress in their use has been remarkable. The direct acting cylinder air hoist has done its work admirably, and now the want of a better device which will be free from the troublesome effects of leakage and lack of sustaining power, as well as one which does not require head room equal to the lift, is recognized. In the hoist under consideration there is no piston packing working against a more or less rough cylinder, no danger of leaky valves, piping or piston packing, which will lower the load, and no spring to the hoist when part or the whole of the load is removed. The operation of the motors is controlled by a valve which starts, stops and reverses them, and is worked by a handle shown at the right hand side of the hoist in the illustration. Further information will be supplied by Mr. F. V. Green, of the Empire Engine and Motor Company, 26 Cortlandt street, New York, the manufacturers of this hoist.

ECONOMICAL LOCOMOTIVES.

At a recent meeting of the St. Louis Railway Club Mr. G. W. Rhodes, superintendent of motive power of the C., B. & Q. R. R., spoke on the subject of the economical locomotive and its relation to the track, in part, as follows:

I would say, in a general way, that for railroads in our immediate surroundings, beyond any question, the best engine for both passenger and freight service is what is known as the four-wheel connected 17 or 18 by 24-inch American engine; that is a good engine for pioneer roads and for roads that have not been rebuilt. I want to lay a great deal of stress on the fact that it is the condition of a railroad which govens the question as to what is the best passenger engine and what is the best freight engine.

I will cite a case that we are all pretty familiar with, and that is the matter of bicycles. The people who live out in the country and who have the arduous duty of furnishing the power to get a bicycle over the road, they know what a great difference there is in the character of the road, and in the condition of the road. You take it in Chicago, and I have no doubt in St. Louis also, where we have good roads, good asphalt pavement, and the amount of work that we can perform on a bicycle, the amount of speed that we can make and the ground that we can cover is very much greater than it would be out on some up-and-down, badly constructed road. We can do more work with the same power on a bicycle when we have a good underbed to work on that we can when we have a bad underbed to work on. And it is the same way with an engine. You can do more work with an engine when you have a good underground to work on than you can if you have a bad underground to work on.

Formerly it was the practice to send specifications and drawings to the locomotive builders, and the builder would simply build the engine. That method is gradually changing, and the practice that we are gradually getting into is to specify a condition. To specify a condition in time that the trains are expected to make between two points; to specify the character of rail that is laid; to specify the character of grade, the weight of the trains and the curvature, and then to ask the locomotive builders to build the engine that will do this work and also guarantee that the engine will perform it, and the payment is not made until the engine does perform it. So it is pretty clear, I think, that the conditions govern the question as to what is the best passenger engine and what is the best freight engine.

There is another feature of this subject, as to the change which improved conditions of the road will bring about in engines. I think that it is often the case that new engine construction has been spoiled by the overconfidence of the motive power men, and very often the overconfidence of the manager of the railroad, in the representations which are made to them requiring a new type of engine. My experience has been that when a new engine is built, whether it is built at a railroad company's shop or whether it is built at the shop of a locomotive builder, it will be found that in a great many particulars the engine is decidedly weak; that the best calculations have not been able to make the engine strong enough; at first in one part and then in another part the machine fails, and then a third part will fail, and as those failures occur the parts are strengthened, and finally, after a few years' service, this new type of engine is reconstructed and rebuilt in such a way that it is strong enough to go into general service and you are ready to have more engines of that class built.

Now, the mistake that is made very often is in the overconfidence of some builder or the overconfidence of some superintendent of machinery, who will order a dozen or fifteen or twenty engines of a new type, and then, in place of having these failures occur on a single engine, they occur on twenty or thirty, the effect being that it practically condemns the entire lot after being used on the road, whereas, if but one engine had been purchased, it might have been worked into a good engine by remedying these defects as they were discovered. Therefore, I would advise those who wish to make a change in their type of engine not to build fifteen or twenty of the same kind at once, but confine themselves to one, and make a thorough test of that one engine before introducing a large number on the road.

In concluding, I would endeavor to impress upon members of the club and the railroads generally that what we want is, to my mind, more mechanics in the track at the present time, rather than more work in the locomotive.

In the same discussion Mr. J. A. Carney, master mechanic of the C., B. & Q. R. R., made the following remarks with reference to small locomotives:

Has the small engine seen its day? This is a question so much dependent upon local conditions that it cannot be answered definitely yes or no, and might be supplemented by the question: "Has the large engine seen its limit, and is it the engine to be desired for all classes of service?"

The majority of the small engines of to-day are the remains of what was once the main equipment of many of our railroads, and it is their light weight and low boiler pressure that makes them small. In merchandise freight and stock trains, and in fast passenger and mail service these engines are outclassed by the large engine, and they failed principally because of their lack of boiler capacity.

The principal advantages of the large over the small engines are: First, they haul more cars; second, it costs less per car mile in wages to haul them.

The amount of fuel per loaded freight car mile is about the same whether the engine be large or small. The cost of repairs of the small engine is decidedly in its favor. Therefore, in comparing large and small engines in freight service, there is little choice so far as fuel consumption is concerned. The extra cost of repairs of the large engine is entirely overshadowed by the saving in train crews' wages, and in its extra earning capacity, so that for average main-line work the small engine has seen its day. On the Northern Pacific the purchase of 50 heavy engines has been the means of laying up 95 small engines. What the saving has been I am unable to learn, but it must be large enough to fully warrant the change. Where the traffic is large and the grade heavy, as it is in portions of the Northern Pacific, the large engine has become a necessity. About 25 per cent. of the savings in engines has been accomplished by making longer runs. Some of the more level roads have adopted the medium-sized engines, and have spent money in leveling and straightening their permanent way that otherwise would have been spent in the purchase of larger engines. On such a road the medium-size engine will haul almost all the cars that can be put behind it, and in many cases the length of the train is limited by the length of the sidings.

The small engine is still being used on branch lines where the freight business is not large enough to warrant the use of a large engine, and where, in many cases light track and light bridges would not permit of the use of larger engines even if the service demanded it. For branch passenger work and light suburban service the small engine answers every purpose, and will be maintained for that class of service. The great disadvantage of the small engine of to-day is its low boiler pressure, and the small engine of the future will be one which is capable of carrying 160 to 180 or more pounds of steam. That there are two many small engines to-day there can be no question. Many of them will be replaced by large engines, and a few will be rebuilt with boilers capable of carrying high pressure.

In conclusion, the size of an engine depends upon the service required of it, and for certain classes of work the small engine is just as much in demand to-day as it was 20 years ago.

TESTS ON THE CHICAGO STORAGE BATTERY RAILROAD.

It is well known that the Englewood & Chicago Electric Steel Railway has operated 20 cars on its lines using the storage battery, and at the beginning of this winter it was decided

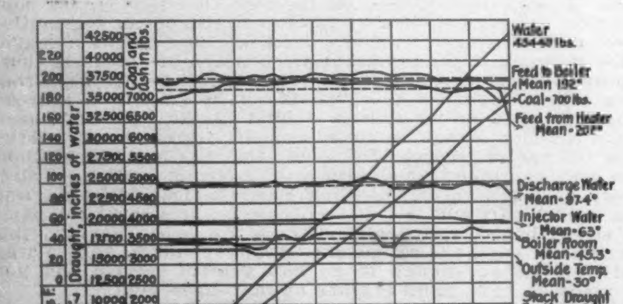


Fig. 1—Boiler Test.

to test the plant in order to determine the presence and extent of defects which might otherwise exist without attracting attention. The tests were made under ordinary working conditions and represent the conditions of usual practice. They were carried out by Mr. George A. Damon, assisted by Prof. T. P. Gaylord and a corps of students from the Armour Institute. We are indebted to Mr. G. Herbert Condict and to the "Western Electrician" for the data and diagrams.

The boiler plant includes three Heine water-tube boilers rated at 200 boiler horse-power each, fitted with Roney mechanical stokers. The engines are triple expansion, condensing, of the Willans central-valve type made by the M. C. Bullock Manufacturing Company, of Chicago. The plant at present contains two of these engines, each of which has two lines of tandem

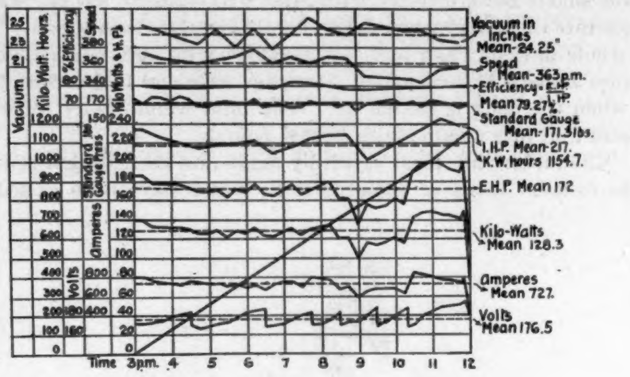


Fig. 2—Engine and Generator Tests.

cylinders rated at 200 horse power at a speed of 380 revolutions per minute.

The engines are directly connected by the "Arnold" method to four six-pole, shunt-wound Walker generators, rater at 190 KW. each when running at 380 revolutions per minute.

Each engine exhausts into a Worthington jet condenser, from which the condensed steam and heated injection water is raised by means of the air pump about 35 feet to the top of a Worthington cooling tower, in the bottom of which it collects, ready to be again used in the condenser.

The boiler feed pumps are of the Worthington duplex compound type, and ordinarily take their supply from the well of the cooling tower, pumping it through a closed feed-water heater in the exhaust line of the pumps, and thence through the economizer to a common feed-water heater above the boilers.

The hot flue gases from the boilers pass from the uptakes into a brick smoke flue extending the entire length of the boiler room. In a brickwork extension of this flue, located between the power house proper and the stack, is installed a Green economizer, with passages and dampers so arranged that the

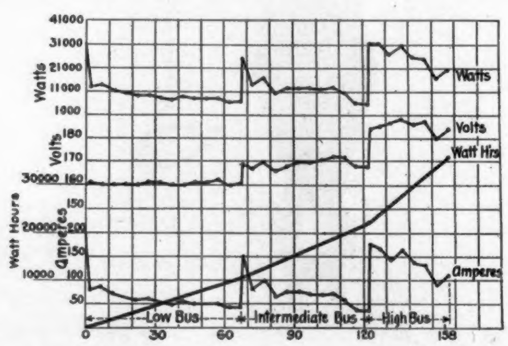


Fig. 3—Charges of Storage Battery Cells.

economizer pipes may be made to intercept the hot flue gases.

Several tests were made, and those to which we direct attention were made on Nov. 26, and Fig. 1 shows the results of the boiler test on that day, while Fig. 2 gives the data obtained from tests on the engines and generators at the same time.

The tests were made on one boiler, one engine and two generators, and the three-voltage method of charging the batteries was not used in these cases. The price of the coal at the plant was $1.90 per ton, and from five tests its calorific value was found to be 10,145 B. T. U. per pound. It had 48 per cent. fixed carbon, 33 per cent. volatile matter and combustible, 6 per cent. of moisture, 3 per cent. sulphur and 10 per cent of ash. The cards were taken every thirty minutes and showed an average indicated horse-power of 217, and an average electrical horse-power of 172, with an average all-day efficiency of 79.3 per cent. The theoretical evaporative efficiency of 10.5 pounds of water per pound of coal, and the evaporation from and at 212 degrees per pound of dry coal, was 6.6, giving an efficiency of the boiler and firebox of 62.86 per cent., which was obtained while the boiler was 26 per cent. under-loaded. The equivalent evaporation per pound of combustible was 8.22, so that the efficiency of the boiler alone was 78.3 per cent., and the boiler loses by radiation and other causes 21.7 per cent., while the fur-

nace is to be charged with 14.44 per cent. of the lost heat, and the remainder 62.86 per cent. appears in the steam.

The test shows that the engines used 18 pounds of steam per indicated horse-power, but it should be remembered that among the unfavorable conditions, the engines were overloaded and had a vacuum of but 24¼ inches. The indicator cards taken with one engine operating one generator showed a friction load of 32.26 indicated horse-power, which is but about 15 per cent. of the average indicated horse-power. The commercial efficiency of the generator is shown to be 93.1 per cent., which efficiency

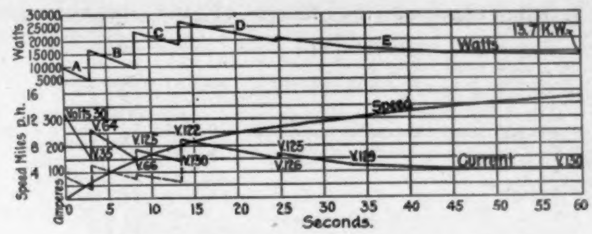


Fig. 4—Average of Five Acceleration Tests.

was obtained when the generator was running 32 per cent. below its rated capacity. The total efficiency from the coal pile to the switchboard was 5.58 per cent. The cost of fuel for a net kilowatt hour on the switchboard of the station tested is shown to be .611 cent. As the result of a two days' run with coal at the price named the cost of fuel per car mile was .996 cent, and the pounds of coal per net kilowatt hour were 6.44.

Fig 3 gives the result of the readings taken on one of the cars every five minutes during the test while it was performing regular service, and Fig. 4 shows the results of a speed trial for 60 seconds. In this figure A, B, C, D and E were the readings obtained for the watts used, while the controller was placed at the five points representing the connections as follows: A, the four sets of batteries in parallel; B, batteries in series parallel in sets of two; C, batteries in series with resistance; D, batteries in series without resistance; E, same as D with field of motor shunted. The speed of 15 miles an hour attained at the end of the 60 seconds was after a run of 986 feet, showing at a glance that it is hardly worthy of comparison with the speed of electric and other cars which have been recorded, but the equipment of this car was designed to enable it to attain normally a speed of but 15 miles an hour. The tests were made on a 13½ ton car, driven by a 50 horse-power Walker four-pole series motor. The entire current used at any one time passed through the armature, so that the ammeter was inserted in the positive brush leads.

The results of the tests point to the suggestion that the engines should be overhauled, the economizer flue repaired, and the question of securing improvements in the fuel as to quality and cost should be taken up.

A STEEL FRAME BOX-CAR.

In an interesting paper, read at the December (1897) meeting of the Northwest Railway Club, Mr. H. H. Vaughan presented a design for a 40-foot, 60,000-pound box-car which has some novel features, among the most important of which is the use of the side framing of the upper part of the car for carrying the load, the object of this being to reduce the weight of the car to the lowest terms. The load in Mr. Vaughan's design is provided for entirely by the car sides, and the center sills are supported and are used for local strength and for the pulling and buffing stresses. The car is 8 feet 6 inches wide over the side sills and has a total floor space of 330 square feet, which will accommodate a load of 60,000 pounds. Mr. Vaughan describes the design in the following words:

The general design is shown by Fig. 1, and it will be seen that the truss is of the ordinary "N" type, with posts in compression. The transoms are 30 feet centers, and the floor is carried by four beams at the panel points, which are spaced about 6 feet apart. Each of these floor beams would carry a load of 9,300 pounds if the load were uniformly distributed, but I consider that the possibility of heavy local loading must be taken into account, and for this I have allowed a double load of 18,600 pounds on one floor beam, but under these circumstances have taken the load on the adjacent floor beams at 4,700 pounds, making as before a total of 28,000 pounds for three beams. I believe that such an assumption will be found to

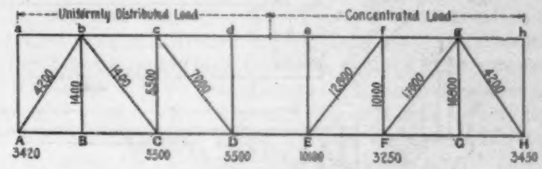


Fig. 2—Stress Diagram.

meet all cases that will be encountered in practice, as no machinery or metal will be loaded that would give rise to greater local weights.

The diagram Fig. 2 shows the stresses on the framing, the left-hand side being for a uniformly distributed load and the right-hand side for a load concentrated as above described, but symmetrical with respect to the center. The weight of the frame sheathing, roof, etc., is included. The allowable stresses in the various members are taken as follows:

On framing, 12,500 pounds per square inch for tension, 8,000 pounds per square inch for compression.

On rivets, 7,500 pounds for shearing, 15,000 pounds per square inch for bearing.

By reference to Fig. 1 it will be seen that the posts and braces are made of 3-inch channel, 5 pounds per foot, and the maximum stress will be 10,000 pounds for tension and 6,800 for compression. The transom post is a 5-inch channel, 6.5 pounds per foot, and the stress on it is 7,600 pounds per square inch. The side plate is a 4-inch channel 5.5 pounds per foot; the maximum strain for this occurs between the door posts, and for a uniform load is 8,300 pounds per square inch, but as this is a continuous section, an excess is perfectly allowable, and it is prevented from buckling sideways by the roof, fascia boards and door track.

The buffing and pulling strains in this car are taken by two 10-inch channels, 16.5 pounds per foot, which run the entire length of the car. The combined area of these is 9.8 square inches, or as great as that in the shank of the coupler and in my opinion should be strong enough to resist any shock that will not entirely wreck the car. The collapsing strength as a column is about equal that of the cour center sills in a 60,000-pound car, and would appear ample by that comparison.

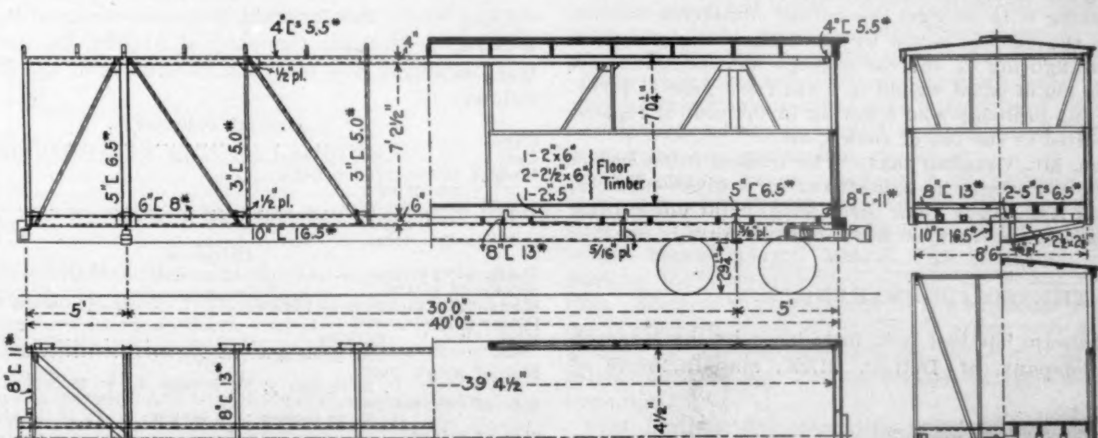
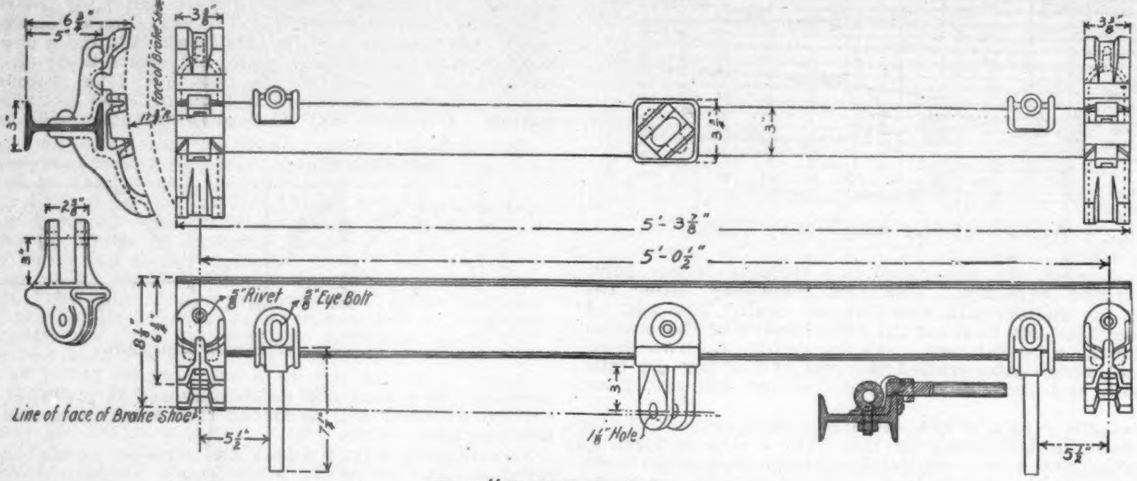


Fig. 1—Design for 60,000-Pounds Capacity Box-Car.

The paper also treats of the resistance to bulging of the ends and sides of the car, showing the necessity for providing for these stresses especially in steel members acting as struts, because the fiber stresses increase very rapidly under combined

compression and bending, and also because steel has less margin between elastic limit and rupture than wood. To guard against these stresses the three-inch channels shown at posts and braces are placed with their webs at right angles to the sides, or the ends, of the car, which gives a strength of about four times that of wooden posts. Another feature of the design is the arrangement of the posts so that the loads come upon the outside of the posts at the top ends and are transmitted to the car at the bottom on the inside of the posts whereby the eccentric loading is almost entirely neutralized. To guard against stresses caused by poling or pushing the car from one corner, the designer uses diagonal braces from the corners of the car to the centers of the body bolsters. He considered it desirable to attach the draft rigging directly to the sills by riveting, which would probably save repairs.



The "Solid" Brakebeam.

The weight of a car body built on this plan was put at 17,500 pounds, which included all attachments and fittings above the trucks. The details of the weight are as follows:

	Pounds.
Steel frame with centerplates and attached castings	6,440
Floor beams, belt rails and railing strips	1,350
Roof and running board lumber	2,150
Sheeting, side and end door lumber	2,470
Floor	1,270
Coupler and draft rigging, deadwood, etc	1,220
Brakes	1,980
Side and end door iron work	220
Hand holds, corner plates, etc	250
Bolts, nuts, etc	160
Total	17,510

The total weight of a wooden car body of this size and capacity was 20,000 pounds, or 2,500 pounds more than that of the steel car, the difference being in the first two items in the list. Allowing for variations which might be required in his design after placing it in service, the author considered one ton per car to be the amount saved by his design over a wooden car. Then by figuring on the car mileage he places the cost of hauling one ton of extra weight in a car for a year at $27.00; this amount, and probably also a saving in the cost of repairs, should be credited to the use of such a car.

In conclusion, Mr. Vaughan says: "The trussed frame car in some form or other offers the lightest car for a given capacity, and while it is less sturdy than those with metal underframe alone, it appears to me the most advantageous form to use."

THE "SOLID" BRAKEBEAM.

A new brakebeam has just been introduced by the Monarch Brakebeam Company, of Detroit, Mich., manufacturers of

The "Solid" Brakebeam.

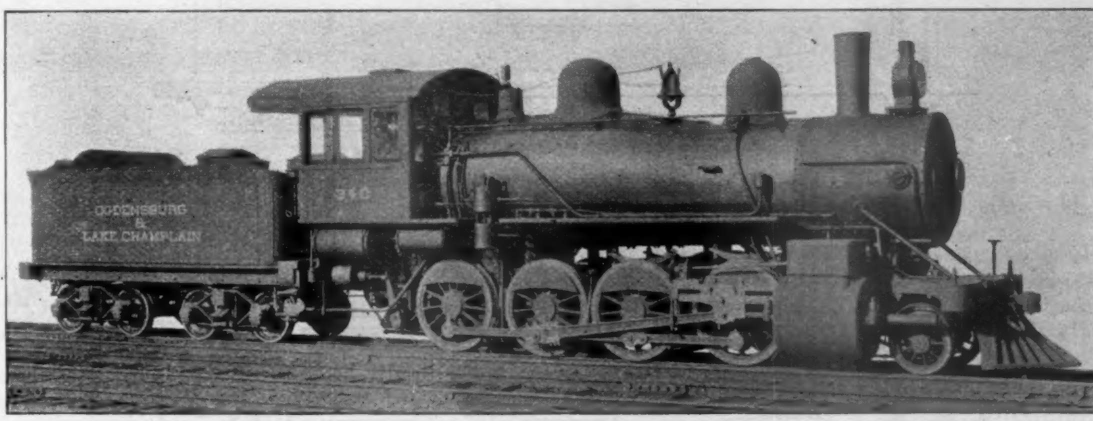
the beam which was illustrated on page 381 of our issue of November, 1897. The new beam is made of an I beam, rolled specially for this purpose, and to this the brake heads, fulcrums and guards are attached. Besides the five-inch I beam, five malleable iron castings and the guards complete the structure, which weighs 80 pounds. The wheel guards are secured to the beam by clips held in place by an eye bolt, to which the safety hangers are attached. The guard pins are removed by loosening this eye bolt and new ones may be put in without difficulty. The pin is held in position by being notched to fit the edge of the flange of the beam, against which it is pressed by the clip. The details of construction are clearly shown in the engraving. The brake heads are interchangeable and are strengthened by double ribs and the same head is used for either outside or inside hung brakes. A special claim for strength is made for the beam, which is guaranteed by the manufacturers to stand the Master Car Builders' test.

COMPOUND CONSOLIDATION LOCOMOTIVES—OGDENSBURG & LAKE CHAMPLAIN RAILROAD.

The Schenectady Locomotive Works have just completed a compound consolidation locomotive for the Ogdensburg & Lake Champlain Railroad, the chief dimensions of which are given in the accompanying table, and the general appearance of which is shown in the engraving prepared from a photograph. The engine has Allen-American balanced valves, McIntosh blow-off cock, Westinghouse-American brake on drivers and tender and for train, magnesia sectional lagging by the Keasbey & Mattison Company of Ambler, Pa., and the Leach track sander. The chief characteristics of the design are as follows:

General Dimensions.	
Gage	4 feet 8½ inches
Fuel	Bituminous coal
Weight in working order	153,000 pounds
" on drivers	135,500 pounds
Wheel base, driving	15 feet
" " rigid	15 feet
" " total	22 feet 10 inches
Cylinders.	
Diam. of cylinders	H. P. 22 inches, L. P. 34 inches
Stroke of piston	28 inches
Horizontal thickness of piston	5¾ inches and 4¾ inches
Diam. of piston rod	3¾ inches
Kind " " packing	cast iron rings
" " " rod packing	Jerome metallic
Size of steam ports	H. P. 20 inches × 2⅛ inches, L. P. 23 inches × 2⅛ inches
Size of exhaust ports	H. P. 20 inches × 3 inches, L. P. 23 inches × 3 inches
Size of bridges	1⅜ inches
Valves.	
Kind of slide valves	Allen-American balanced
Greatest travel of slide valves	6½ inches
Outside lap " " "	H. P. 1¼ inches; L. P. 1⅛ inches
Inside clearance " "	⅛ inch
Kind of valve stem packing	Jerome metallic
Wheels, etc.	
Diam. of driving wheels outside of tire	54 inches
Material " " centers	Cast steel
Driving box material	Main, cast steel; balance, steeled cast iron
Diam. and length of driving journals	Main, 8½ inches diam. × 11 inches; balance, 8 inches diam. × 11 inches
" " " main crank pin journals	6½ inches × 6 inches; main side, 7 inches diam. × 5¼ inches
" " " side rod crank pin journals	Intermediate, 5½ inches × 5 inches; F & B., 5 inches diam. × 3¾ inches

Engine truck, kind	Two wheel, swing bolster
" " journals	6 inches diam. × 11 inches
Diam. of engine truck wheels	30 inches
Kind " " "	Standard, cast steel spoke center
Boiler.	
Style	Extended wagon top
Outside diam. of first ring	62 inches
Working pressure	200 pounds
Material of barrel and outside of firebox	Carbon steel
Thickness of plates in barrel and outside of firebox	⅝ inch, 11-16 inch, ½ inch and 7-16 inch
Firebox, length	108 3-16 inches
" width	41 inches
" depth	F., 67⅞ inches; B., 64⅞ inches
" material	Carbon steel
" plates, thickness	Sides, 5-16 inch; back, 5-16 inch; crown, ⅜ inch; tube sheet, ½ inch
" water space	Front, 4 inches; sides, 3½ to 4 inches; back, 3½ to 4½ inches
" crown staying	Radial stays, 1⅛ inches diam.
Tubes, material	Charcoal iron, No. 12 W. G.
" number of	306
" diameter	2 inches
" length over tube sheets	13 feet
Fire brick arch, supported on	Water tubes
Heating surface, tubes	2,069.5 square feet
" " water tubes	11.5 square feet
" " firebox	162.1 square feet
" " total	2,243.1 square feet
Grate "	30.8 square feet
" style	Rocking, with drop plate
Ash pan, style	Sectional, with dampers front and back
Exhaust pipes	Single, high
" nozzles	5¼ inches, 5½ inches and 5¾ inches diam.
Smokestack, inside diameter	18 inches at top, 16 inches near bottom
" " top above rail	14 feet 1¼ inches
Boiler supplied by	Two injectors, Monitor, No. 10, R. & L.
Tender.	
Weight, empty	36,300 pounds
Wheels, number of	8
" diameter	33 inches
Journals, diameter and length	4½ inches diam. × 8 inches
Wheel base	15 feet 3 inches
Tender frame	10 inch steel channels
" trucks	4 wheel channel iron, Cen. bearing F. & B., additional side bearings on back truck
Water capacity	4,000 U. S. gals.
Coal "	7½ (2,000 pound) tons
Total wheel base of engine and tender	49 feet 11 inches
" length " " " "	59 feet 5 inches



Schenectady Compound Consolidation Locomotive for the Ogdensburg & Lake Champlain Railroad.

LOCOMOTIVE BOILER LAGGING.*

By Wallace W. Johnson.

Under present conditions of knowledge and methods of engine building, the most vulnerable point in our practice remains the same to-day as in the day of Watt, who laid down this principle, that "The cylinders should be kept as hot as the steam which enters them."

Asbestos and magnesia have been names to conjure with during the past few years. And perhaps this would be an opportune time to remind the members of this club not to be misled by names. When a man, or a company puts out a covering, the substance of which is supposed to be described by the name it bears, I submit that in all fairness, it ought to contain a sufficient amount of the specified material to justify its name; but such is not always the case.

Plaster of paris, or sulphate of lime, is the principal constituent of many of the coverings now found upon the market. Its insignificant cost, the ease and cheapness of moulding it into sectional forms, has served to make it more and more relied upon by the makers of low-priced insulating materials. Its price, indeed, is the only quality which can induce any one to employ it. Its lack of stability to resist for any great length of time the action of high temperature, its corrosive action on iron surfaces with which it comes in contact, are drawbacks too pronounced to permit serious consideration of this material by the thoughtful steam users to whom first cost is not the only consideration.

Asbestos is a commercial name for the fibrous form of the minerals amphibole and serpentine. It is really a very valuable mineral. The rock, dissected, yielding fiber fine and silk-like, yet defying furnace heat and chemists' acid.

Among the many uses for which asbestos is employed is the jacketing of heated surfaces for preventing radiation. Like charity, however, it has been made to "cover a multitude of sins," to stand sponsor for a mongrel brood of half-breed coverings and bastard laggings. The constant appropriation of the name asbestos to multitudes of mixtures claiming recognition as non-conducting coverings, justifies a more than passing notice of this substance at this moment. It has long been known that sheep's wool, cotton-wool, hair-felt and other organic fibrous matter possessed great virtues as non-conductors of heat. The large proportion of entrapped air within the interstices of the fibers gives to such materials a power for insulation unknown in the past in mineral substances. No wonder then than the use of asbestos as a lagging with its fibrous, feathery, hair-like strucure, and its fire-resistant qualities, should have seemed so full of promise as a guardian of the fugitive thermal unit. Experience soon taught us, though, that one very vital quality possessed by the organic fibers, namely, elasticity, was lacking to a very considerable extent in asbestos fibers. Light, fleecy asbestos fibers make a very excellent non-conductor, if properly made up; but the vibrations, concussions and mechanical stresses to which boiler coverings are subjected soon break down the air-entrapped structure of asbestos wool, leaving a matted mass of mineral matter, sadly lacking the heat-entrapping air cells.

About sixteen years ago Prof. J. M. Ordway, at that time connected with the Massachusetts Institute of Technology, made a very exhaustive investigation at the instance of the Boston Manufacturers' Mutual Fire Insurance Company, regarding the non-heat-conductivity of a number of materials. Some of the substances tested, although possessing non-conducting properties of the highest order, were deemed unsafe or unfit for boiler or pipe covering, on account of their liability to carbonize, or take fire, or because of their corrosive action upon iron.

Prof. Ordway, in commenting upon some of the materials he had been testing, especially those of a fibrous character, said: "These substances keep the air still by virtue of their fibers or particles. The asbestos of 18 had smooth fibers which could not prevent the air from moving about. Later trials with an asbestos of exceedingly fine fibers have made a somewhat better showing, but asbestos is really a poor non-conductor. By reason of its fibrous character it may be used advantageously to hold together other incombustible substances."

Mineral wool consists of the slag from iron furnaces blown into a fibrous condition when melted. It is an excellent non-heat conductor when in a fluffy condition, by reason of the large

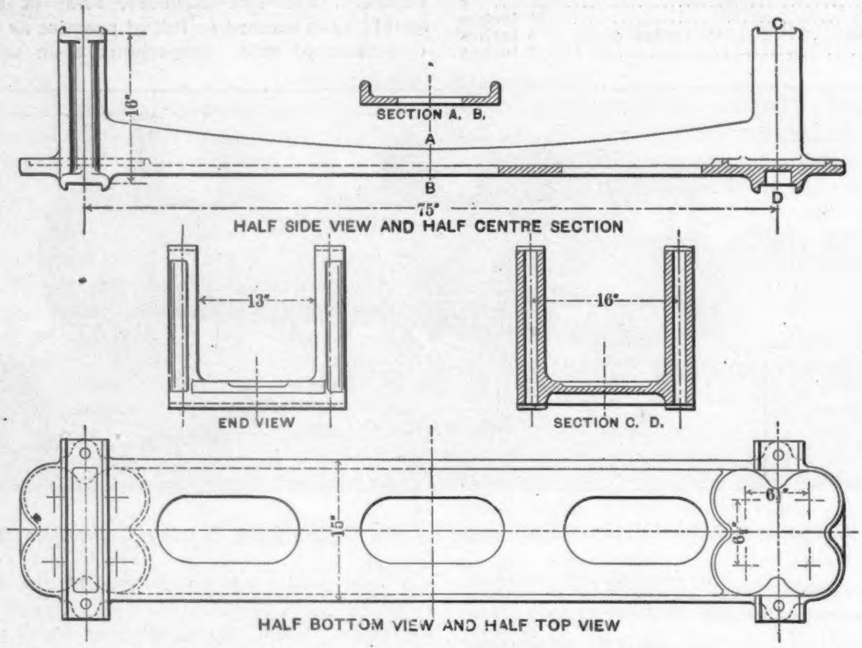
* From a paper read February 17, 1898, before the New York Railroad Club.

amount of entrapped air it will hold; but when converted into a solid condition, it becomes a rather quick conductor.

Magnesium carbonate, popularly known as magnesia, possesses the quality of porosity to a higher degree than any other mineral. One hundred volumes of carbonate magnesium will hold entrapped, from eighty-five to ninety volumes of air. It is by virtue of this great proportion of air cells that it possesses its well known heat insulating qualities. In the magnesia covering placed upon the market we find asbestos fiber to the extent of about one-tenth of the weight of the covering. The office of the asbestos as previously indicated is, by reason of its fine fibrous character, to lend mechanical strength to the covering, while the magnesia furnishes the insulating property.

COMBINATION SPRING PLANK, SPRING SEAT AND COLUMNS FOR CAR AND TENDER TRUCKS.

The accompanying engraving illustrates a design for an improvement in car and tender trucks, which embodies the spring plank, spring seat and columns in a single steel casting. The views shown are in sufficient detail to be readily understood without further explanation as regards the construction. The design is by Mr. Thomas N. Gallagher and the Shickle Harrison and Howard Iron Company, St. Louis, founders of open hearth steel castings, are the manufacturers.



Combination Spring Plank, Spring Seat and Columns.

The advantages urged for this device are a considerable reduction in the number of pieces used in the construction of trucks and a very rigid and substantial construction. A number of these castings have been put into service under tenders and the reports from them indicate that they are very satisfactory in practice. The castings are made for either coil or elliptic springs, the form shown in the engraving being arranged for coil springs. They are made of open hearth steel. The general dimensions are shown, but these are, of course, varied to suit the design of the trucks. We think the reduction in the number of parts composing a truck which this plan offers an important improvement, which will be appreciated, especially by those who have strong preferences for trucks of the arch bar type.

The Union Station in Chicago is to be rebuilt and rearranged at a cost of about $30,000. The plans have been prepared by Mr. D. H. Burnham, of Chicago, and it is understood that there will be a convenient entrance to the track platforms direct from Adams street, as well as by means of a general entrance on Canal street.

EIGHT-WHEEL PASSENGER LOCOMOTIVES—IMPERIAL GOVERNMENT RAILWAY, JAPAN.

Twenty narrow gauge American type locomotives have been completed by the Brooks Locomotive Works for the Imperial Government Railways of Japan and through the courtesy of the builders we present an illustration of one of the engines, with a table giving the principal dimensions. The whole design more nearly resembles our practice than is usually found in the locomotives for Japanese railroads. The tender is carried on three axles, but otherwise it is like recent American tenders, except the brakes, which are of the vacuum type. The engine has also vacuum driver brakes. The chief dimensions follow:

Description.

Type	eight-wheeled passenger
Name of operating road	Imperial Government Railways of Japan
How many and dates of delivery	twenty, January, 1898
Gauge	3 feet 6 inches
Simple or compound	simple
Kind of fuel to be used	bituminous coal
Weight on drivers	50,400 pounds
" on truck wheels	24,100 pounds
" total	74,500 pounds
" tender loaded	52,000 pounds

General Dimensions.

Wheel base, total, of engine	19 feet 4 inches
" " driving	7 feet
" " total (engine and tender)	38 feet 9 inches
Length over all, engine	28 feet 3½ inches
Length over all, total engine and tender	46 feet 6 inches
Height, center of boiler above rails	7 feet 1 inch
Height of stack above rails	12 feet 1½ inches
Heating surface, firebox	89.9 square feet
" " tubes	965 square feet
" " total	1,054.9 square feet
Grate area	15.2 square feet

Wheels and Journals.

Drivers, diameter	54 inches
Drivers, material of centers	iron
Truck wheels, diameter	27½ inches
Journals, driving axle, size	6½ by 8 inches
Journals, truck axle, size	4½ by 7 inches
Main crank pin, size	4 by 4½ inches

Cylinders.

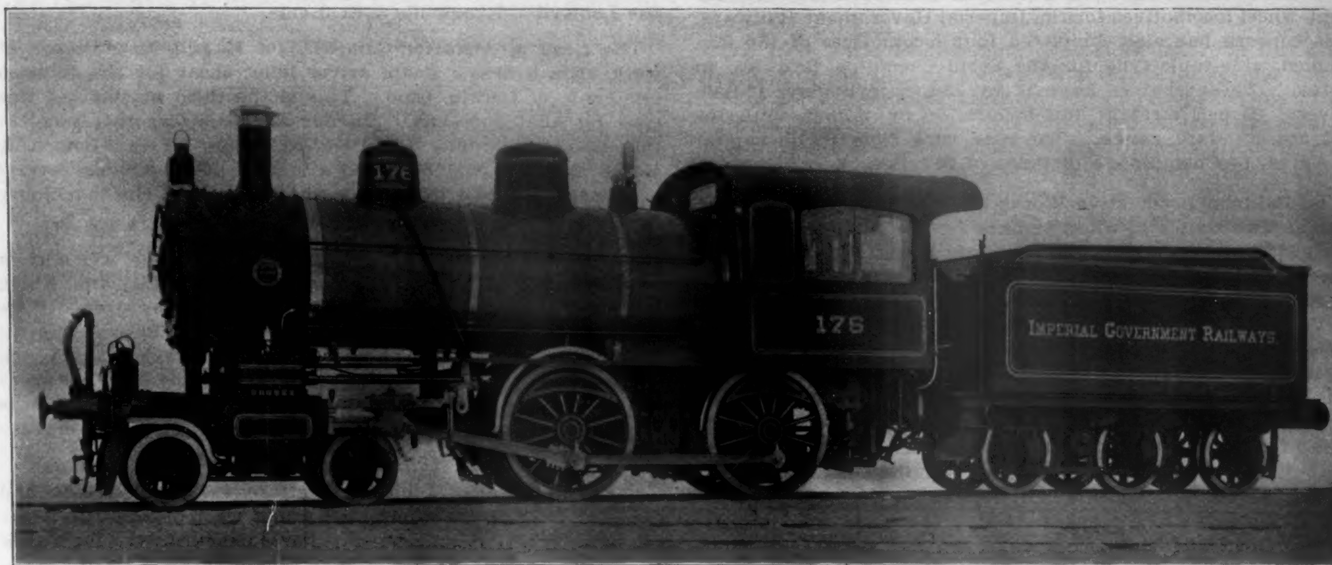
Cylinders, diameter	15 inches
Piston, stroke	22 inches
Piston rod, diameter	2⅞ inches
Main rod, length center to center	5 feet 10 inches
Steam ports, length	14 inches
Steam ports, width	1⅛ inches
Exhaust ports, length	14 inches
Exhaust ports, width	2½ inches
Bridge, width	1⅛ inches

Valves.

Valves, kind of	Richardson
" greatest travel	6¼ inches
" outside lap	1 inch

Boiler.

Boiler, type of	straight top
" working steam pressure	160 pounds
" material in barrel	steel
" thickness of material in barrel	½ inch
" thickness of tube sheet	½ inch
" diameter of barrel	54 inches
Seams, kind of, horizontal	quadruple riveted
Seams, kind of, circumferential	double riveted
Crown sheet stayed with	radial stays
Dome, diameter	22 inches



Passenger Locomotives, Imperial Government Railways, Japan.

Firebox.

Firebox, type	sloping, over frames
" width	6 feet 6 inches
" length	2 feet 5½ inches
" depth front	50½ inches
" depth back	51½ inches
" material	copper
" thickness of sheets, sides, door, ½ inch; crown, ½ inch; flue sheet, ⅞ and ½ inch	
" brick arch	on studs
" mud ring, width, front, 3½ inches; sides, 2½ inches; back, 3 inches	
Water space at top......front, 3½ inches; sides, 5 inches; back, 4 inches	
Grate, kind of	rocking
Tubes, number	210
" material	solid drawn brass
" outside diameter	1¾ inches
Tubes, length over sheets	9 feet 7 1-16 inches

Other Parts.

Exhaust nozzle, single or double	single
" " variable or permanent	permanent
" " diameter	4, 4 3-16, 4⅜
Netting	wire
Stack, straight or taper	taper

Tender.

Type	6-wheel, rigid pedestal type
Tank, type	sloping, flat top
Tank, capacity for water	2,400 gallons
Coal capacity	5 tons
Kind of material in tank	steel
Thickness of tank sheets	¼ and 3-16
Type of under-frame	iron
Type of springs	half elliptical
Diameter of wheels	36 inches
Diameter and length of axle journals	4¼ by 8 inches
Length of tender over bumper beams	16 feet 2 inches
Length of tank	14 feet 6 inches
Width of tank	7 feet 4 inches
Height of tank, not including collar	48 inches
Height of tank over collar	66 inches
Type of draw gear...front and rear screw couplings and spring buffers	

Engines provided with:
Three headlights with 8-inch semaphore lens.
Smith's automatic vacuum brake on all drivers and on tender.
One Detroit No. 2 double-sight feed lubricator.
Three-fourths-pint Detroit lubricators on steam chests.
Two Kunkle 2½-inch safety valves.

CHICAGO AND DENVER TRAIN SERVICE.

The Chicago & Northwestern announces a new 28-hour train between Chicago and Denver, in conjunction with the Union Pacific. The train will leave Chicago at 10 a. m., arriving at Denver at 1:30 the following day. Returning it will leave Denver at 3:30 in the afternoon and arrive in Chicago at 8:50 in the evening of the following day.

The Burlington also announces a fast train, leaving Chicago at 10 a. m., and making the run in 27 hours, or one hour less than the time of the Chicago & Northwestern train.

Mr. G. W. Rhodes at Purdue University.

Mr. Godfrey W. Rhodes, Superintendent of Motive Power of the C., B. & Q., delivered an address before the engineering students of Purdue University, on Feb. 19, upon "Experiences in the Motive Power Departments of Railways." Not many men have enjoyed a wider experience than that which has been had by Mr. Rhodes, and few have observed more carefully. His lecture, while dealing with incidents, was full of serious suggestions.

He first discussed the fundamental principles which apply in the management of men, and urged the value of painstaking and considerate attention on the part of heads of departments, sketching briefly some of his personal experiences and leading his audience to a broad view of the responsibilities resting upon those who are called to direct the work of others.

The dependence of practice upon the application of correct principles was illustrated by a convincing discussion concerning the defect of a detail of a locomotive, which had long been standard on a leading road, and which, though parts were repeatedly increased in size, could not be held together until the general design was corrected.

He presented in a charming manner the necessity for conducting experimental investigations under conditions of actual service, and illustrated his point by showing a switch lens which, when tested by sunlight, as is often done, was blue, but which when illuminated by the yellow light of a candle quickly became green; also by exhibiting two red glasses which were of entirely different shades under sunlight, but practically the same when illuminated by yellow light, that is under conditions common to practice.

The value of experimental research was illustrated by a brief account of the Burlington Brake Tests, and the modesty with which the speaker referred to the difficulties encountered, and of the far-reaching effect of the results obtained, aroused but slight suspicion in the minds of the student audience that he was the masterful leader in that great work.

EQUIPMENT AND MANUFACTURING NOTES.

The Michigan Central is putting new boilers, to carry 180 pounds steam pressure, on a number of locomotives now having small boilers. The work is being done at the Jackson shops of the road.

The Richmond Locomotive & Machine Works have an order to build two eight-wheel connected locomotives for the Mississippi River & Bonne Terre.

The Schenectady Locomotive Works have an order to build five ten-wheel, compound passenger locomotives for the Minneapolis, St. Paul & Sault Ste. Marie.

The Brooks Locomotive Works have received orders to build two switching engines for the Carnegie Steel Company, Limited, three 10-wheel freight locomotives for the Flint & Pere Marquette, two locomotives for the Mexico, Cuernavaca & Pacific. Six six-wheel switching engines have been completed for the Cleveland, Cincinnati, Chicago & St. Louis, and also twenty eight-wheel locomotives for the Imperial Government Railways. This concern has also completed four locomotives of the six-coupled, side-tank type for the Seoul-Chemulpo Railway, in Korea. These engines have 14 by 22-inch cylinders, 42-inch drivers, 46-inch straight top boilers, 54 by 35-inch fireboxes and are standard gauge. The road runs from Seoul, capital of Korea, to Chemulpo, a distance of 25 miles.

The Baldwin Locomotive Works have received the following orders: Two simple 10-wheel engines for the Mexican National, one switching engine for the Atlantic Coast Line, one four-wheel, narrow gauge switching engine and one standard gauge consolidation engine fore the Dora Furnace Company, of Pulaski, Va., two engines for the Gila Valley, Globe & Northern, one inspection locomotive for the Philadelphia & Reading, four six-wheel switching locomotives for the Minneapolis & St. Louis. The Southern Indiana has received the three new passenger engines built by this firm, and they have also completed four locomotives for the Soudan Railway (Egypt), and are building ten 10-wheel locomotives for the St. Louis & San Francisco, four ten-wheel freight engines for the Southern Indiana, nine heavy freight and six heavy fast passenger locomotives for the Philadelphia & Reading. This firm has presented the locomotive "Columbia" to Columbia University, of New York, to be used as a laboratory experimental locomotive.

The Canadian Pacific will build 20 first-class coaches and 10 sleeping cars in its Montreal shops.

The Crossen Manufacturing Company has an order to build 20 tourist cars for the Canadian Pacific.

The Mount Vernon Car Company will build 100 box and 100 fruit express cars for the Mobile & Ohio.

The Wells & French Company have an order for 100 tank cars for the Glucose Sugar Refining Company.

The Lake Superior & Ishpeming has ordered 40 steel cars of 100,000 pounds capacity from the Schoen Pressed Steel Company.

The Bloomsburg Car Company, of Bloomsburg, Pa., will build 100 gondola cars for the Orange Free State Railway Company, of South Africa.

The Milton Car Works, of Milton, Pa., will build 50 tank cars for the Glucose Sugar Refining Company and 10 cars for the S. P. Shotter Company.

The Illinois Car and Equipment Company will build 40 refrigerator cars for the Louisville Packing Company, in which Bettendorf bolsters are specified.

The Harlem & Hollingsworth Company, Wilmington, Del., has received an order from the Baltimore, Chesapeake & Atlantic for three passenger cars.

The Pittsburgh & Lake Erie has placed an order for 100 steel cars with Schoen Pressed Steel Company. These cars are of the Schoen design and are to be self cleaning.

The Chicago, Rock Island & Pacific has ordered from the Rodger Ballast Car Company 25 Standard 60,000-pound capacity ballast cars and one standard distributing car.

The Jackson & Sharp Company is furnishing the Georgia Pine Railway with one 50-foot passenger coach and one combination passenger and mail car of the same length.

The McMyler Manufacturing Company, of Cleveland, has received an order for a $40,000 car dumping machine, from the Cleveland, Lorain & Wheeling Railway, for erection at Lorain, Ohio.

The Pullman Palace Car Company have orders for the following cars: Twenty passenger cars for the Grand Trunk, 20 tourist cars for the Minneapolis, St. Paul & Sault Ste. Marie, three dining cars for the Pennsylvania.

The International Correspondence Schools, of Scranton, Pa., have just received a fine new car built for them by the Jackson & Sharp Company. It is to be used for the purpose of interesting persons in all parts of the country in the work of the schools.

The Missouri Car and Foundry Company have orders for the following cars: Five hundred coal cars for the Missouri Pacific, 50 cars for Wells, Fargo & Co., 50 cars for the Shreveport & Red River Valley Railroad, 300 box cars and 200 coal cars for the Louisville, Evansville & St. Louis.

The Long & Alstatter Company, of Hamilton, Ohio, are at work upon a heavy steam driver billet shear for the Johnson Company, of Lorain, Ohio. This is the third machine of this type for that company. In our article on another page of this issue, describing the Concord Shops of the Boston & Maine Railroad, will be found a statement concerning several machines furnished by these manufacturers. The machinery for these shops was selected with great care.

The New York Metal Company, makers of the well-known "Cross and Crown" brand of anti-friction metal, and which abolished its New York city offices in 1892, has opened New York headquarters at 42 Dey street, with A. E. Prier in charge. Mr. Prier's service with the company dates back many years, his previous relation being that of chief salesman. The company's plant is located at Fulton, New York. Thos. D. Lewis is general manager, and the business is being pushed very aggressively.

The S. A. Woods Machine Company, of Boston, long and favorably known for their high-grade wood-working machinery, have made an addition to their business in the form of a department for the special work of building machinery for the construction and repair of railroad cars. They have joined interests with the Carse brothers, of Chicago, and will take up the building of car machinery designed by Mr. David B. Carse and O. E. Ahlander, who was formerly chief draftsman and designer for Messrs. Greenlee Brothers & Co., of Chicago. Mr. Carse has an enviable reputation for railroad work, and his opinion with regard to the arrangement of mill machinery is sought after. He is manager of the new department, and Mr. J. B. Carse, his brother, is assistant manager, with headquarters at 64 Wabash avenue, Chicago. Mr. Ahlander is superintendent of the car department at the works of the company in Boston. We are informed that they have fitted out the Consolidated Cattle Car Company's works at Corwith, Ill., and the shops at Middletown and Norwich, for the New York, Ontario & Western, and that they are now engaged in building hollow chisel mortising and high-speed boring machines for the Louisville & Nashville and for the Lake Shore and Michigan Southern roads. A representative of this paper was recently told by a prominent car builder, who was unwilling to have his name mentioned, that this concern furnished the best woodworking machinery to be had.

The Sargent Company, of Chicago, report a very large business in railway supplies during the past few weeks. They inform us that orders for the new Diamond "S" shoe are coming in rapidly. This shoe, it will be remembered, was fully described in our columns in a recent issue. It is manufactured of cast iron, with inserts of expanded steel, giving great friction and long life to the shoe, without injury to the tire. They have made tests on a large number of railroads with uniform satisfaction, the result of which is shown by the large number of orders on their books. Mr. W. D. Sargent, the vice-president and general manager of the Sargent Company, has just returned from England and the Continent, where he has been engaged in introducing the Diamond "S" brake shoe. Notwithstanding the proverbial conservatism of foreign railway managers for American inventions, the merits of the shoe are so clear, that several of the railroads in England are already using them, and the prospect for a large extension of this business is most flattering. The Sargent Company have recently published the second volume in their series on the Diamond "S" brake shoe, giving the results of the remarkable tests of this shoe, which were conducted on the brake shoe testing machine at the shops of the Westinghouse Air Brake Company at Wilmerding, Pa. They will be pleased to furnish copies of these pamphlets, together with results of service tests, to railroad men, upon request.

The electric lighting equipment for passenger cars, as furnished by the American Railway Electric Light Company, of 14 Stone street, New York, was described in our issue of June, 1897, page 201. We are now informed by Mr. Wilbur Huntington, president and general manager of the company, that besides the Pullman car "Mabel," now running in regular service on the Pennsylvania Railroad, the private car, No. 503, used by General Manager Loree, of the Pennsylvania lines; the Canadian Pacific sleeper, "Winchester," and a car on the Boston & Albany Railroad, have been equipped with the apparatus, which is reported to be satisfactory to the officers of the roads mentioned.

The Rhode Island Locomotive Works are reported to have filed a petition in insolvency with assets of $518,000 and liabilities of $616,700. Mr. Charles H. Wilson is custodian.

The Carpenter Steel Works, of Reading, Pa., have received an order for 27,000 projectiles for the Navy Department. They will range in weight from 480 to 1,080 pounds, and will be made in a hurry.

Twenty all-metal gravity dumping cars, of the Goodwin type, have been leased by the Goodwin Car Company, of 96 Fifth Avenue, New York, for five years, to be used on the new aqueduct for New York city, at Jerome Park.

The order for 32 electric locomotives for the Central London Underground Railroad has been taken by an American firm. The locomotives will weigh about 45 tons, and will have a total of about 800 horse-power in the motors. The trains will have five cars each, making a load of 150 tons, which is slightly heavier (about 10 tons) than the average train on the Manhattan Elevated in New York. The speed will be 15 miles per hour.

The following directors were elected at the recent annual meeting of the Franklin Steel Casting Company, of Franklin, Pa.; C. W. Mackey, Charles Miller, J. W. Rowland, W. J. Bleakley, O. D. Bleakley, D. H. Boulton, W. H. Forbes, H. M. Wilson and Robert M. Calmont.

The Chicago Pneumatic Tool Company, of which Mr. J. W. Duntley is president, have received a cable order for 19 machines, to go to locomotive works in Russia, which ordered twelve machines about eight months ago. This is an example showing the satisfaction given by the machines, and it is specially worthy of note that this order comes from a country in which labor is very cheap. The reception of the machines in Europe is evidence that their work is considered superior to that done by hand.

The ventilation of passenger cars will always be an important matter with the railroads, and one of the probable effects of recent agitation over the sanitation of cars is to direct attention to the subject anew. Among the ways of getting proper ventilation is to use ventilators through the roofs, and for this purpose the "Pancoast Ventilator" has been found very satisfactory. We have seen exceedingly strong indorsement of this device from well-known railroad men, who have tried several other kinds, and the fact that they are used on the new Waldorf-Astoria Hotel, in New York, is a further reason for considering them successful. These ventilators are reported to be absolutely storm and cinder proof, and they admit no dust or dirt. This concern also manufacture roundhouse ventilators, made of gray or of galvanized iron, which have proved to be very efficient.

The Ingersoll-Sergeant Drill Company, of 26 Cortlandt street, New York, have recently donated one of their latest and best forms of air compressors to Sibley College, on condition that certain experimental investigations relating to the compressing of air be undertaken. The compressor has three cranks, two 7 by 9 inch steam cylinders, two air cylinders, one 12¼ by 9 inches and the other 7¼ by 9 inches; the cylinders are water jacketed, and the compressor is to work to a pressure of 100 pounds on the air side, using steam at 120 pounds pressure. The results of scientific investigations on this compressor at Cornell will be looked for with interest.

D'Amour & Littledale, New York, makers of a sensitive bench drill bearing the firm name, have recently filled orders for firms in Germany, England and other foreign countries.

Mr. Francis Granger, 35 Nassau street, New York, has made several shipments of railroad supplies during the past few weeks to Japan. Among them were shipments of rails, steel beams and other shapes, which is an indication of an increased demand in that country for American goods.

The New York, Philadelphia & Norfolk Railroad has given an order to the Delaware River Iron Shipbuilding and Engine Works for a passenger steamer, for the route between Cape Charles City and Norfolk. She will be named the Cape Charles. The following are the chief dimensions: Length, 230 feet; beam, 41 feet; depth of hold, 15 feet; draft, 9½ feet. The boat will carry 250 passengers and 250 tons of baggage. The engines are triple expansion, with cylinders 14, 32 and 50 inches diameter by 48 inches stroke. The boilers, two in number, are 13 feet in diameter, and will carry 170 pounds pressure.

English capitalists have bought manufacturing properties in this country to a considerable extent, but the purchase of English iron works by American capitalists is not usual, and we are informed by "The Engineering and Mining Journal" that rumors have been prevalent in England that the Dowlais Iron Works in Wales have been bought by an American syndicate. Mr. E. P. Martin, the manager of these works, is now in America, accompanied by Mr. E. Windsor Richards, of the Low Moor Iron Works. He is studying American practice.

The Roberts Safety Water Tube Boiler Company is enjoying a phenomenal run of business and has orders on hand to keep the various plants of the company working night and day for months to come. The company has just shipped from Red Bank four boilers to Moran Bros. Company, Seattle, Washington, which are to be placed in vessels for the Klondike trade. At the Chicago branch, the Marine Iron Works, six boilers, aggregating 1,350 h. p., are being built for Klondike steamers. At the Red Bank works seven boilers, with a total of 1,500 h. p., are building for the Lewis Nixon ship yards, and are to be used in vessels building for the Klondike service, and three other boilers building for the same yard will go to South America.

The Bloomsburg Car Manufacturing Company, of Bloomsburg, Pa., has been awarded the contract to build 100 gondola cars for the Orange Free State Railway, of South Africa. These cars will be equipped with steel frames and steel-tired wheels. Fifteen passenger cars are to be built for the same company. These will have forty-inch, steel-tired wheels and will be similar to an American passenger car, except that they will be smaller. These will be the first cars of this description built in the United States for use in Africa.

The Baldwin Locomotive Works have chartered a steamer to carry twenty-two locomotives to Finland.

William Dinwiddie, the photographer, of Washington, who has been taking a series of views, both scenic and industrial, for the Baltimore and Ohio Railroad, has completed the outdoor work, and is now engaged in making proofs of the eight hundred or more negatives that he secured during the summer and fall. About one-third of this work has been completed, and photographic experts, who have examined it, pronounce it the finest collection of its kind that has ever been taken. One of Mr. Dinwiddie's scenic B. & O. views has received honorable mention in the Salon at the Carnegie photographic exhibit in Pittsburg.

The special business of the Baltimore & Ohio for the month of January included 47 parties, with a total of 1,321 people. Some idea of the attention that this road is now paying to its passenger traffic may be gained from the fact that during the past 18 months nearly 800 passenger cars received thorough and ordinary repairs, 696 being repainted. Nearly all of the equipment is now "Royal Blue," and most of it is equipped with Pintsch gas, the Pintsch light being used on local as well as through trains.

The Boston Woven Hose Rubber Company has removed its extensive offices and warerooms from 275 Devonshire street to the corner of Atlantic avenue and Congress street, Boston. The change gives a much-needed increase in facilities for the management of the business, permitting of carrying a larger stock of goods and of shipping them more promptly, on account of being nearer the shipping points. The new address of the company is 540 Atlantic avenue, Boston, Mass.

The Magnolia Metal Company several months ago sent out a circular to all of the mills and manufacturers and railroads of the United States and Canada, accompanied by a useful fifteen-inch desk ruler, and, requesting a reply stating whether the recipients were using the products of the company, and if so their experience with them. A very small percentage of concerns so addressed ever make response, and taking the number of replies actually received, giving testimony as to the superiority of Magnolia metal, it has been estimated that at least 100,000 concerns in the United States and Canada are to-day using the metal. Testimonials were received through the mails from 2,827 separate concerns or individuals. This number, being nearly 3,000, is a very encouraging result. These testimonials were received from every part of the United States and Canada and were sent in by railway companies, steamship companies, rolling mills, iron and steel manufacturers of every kind and description, machinists, paper mills, cotton mills, woolen mills, wood-working establishments of all kinds, and practically every class of mechanical industry that can be mentioned. This statement is a very remarkable one and shows the wonderful success that the Magnolia Metal Company has had during the past 10 or 12 years in introducing their metal among the mills, manufacturers, jobbers and dealers of the United States and Canada; and their trade is equally as large in foreign countries. This shows what can be accomplished by having a good article well exploited and thoroughly advertised.

The Walker Company, of Cleveland, Ohio, recently finished the largest direct current generator ever built. It was contracted for by the Brooklyn Heights Railway Company, of Brooklyn, N. Y., and its total weight was about 150 tons, the weight of the armature alone being nearly 50 tons. Orders are now being filled for 20 motors for the Metropolitan West Side Elevated Railroad, of Chicago, for 40 double equipments for the Union Railway of New York, and 100 double equipments, including controllers and motors, for shipment to Dresden, Germany.

Our Directory

OF OFFICIAL CHANGES IN FEBRUARY.

Astoria & Columbia River.—T. H. Curtis has been appointed General Manager, with headquarters at Astoria, Ore.

Atchison, Topeka & Santa Fe.—Mr. E. D. Kenna has been chosen First Vice-President. He was formerly General Solicitor. Mr. Paul Morton, heretofore Third Vice-President, has been chosen Second Vice-President.

Baltimore & Ohio Southwestern.—Mr. James M. Percy has been appointed Master Mechanic, with headquarters at East St. Louis, Mo. He was formerly Master Mechanic of the Cincinnati, Hamilton & Dayton.

Bangor & Aroostook.—Mr. C. S. Nason, formerly Master Mechanic of this road, died at Bangor, Me., January 28.

Bellingham Bay & British Columbia.—Mr. W. McLane has been appointed Master Mechanic, with headquarters at New Whatcom, Wash.

Boston & Maine.—Mr. James A. Corey has been appointed Master Mechanic at Portsmouth, N. H.

Bridgton & Saco River.—Mr. Frederick J. Ilsey has been appointed Chief Engineer.

Buffalo, Attica & Arcade.—Mr. W. W. Bell has been elected Vice-President and Treasurer, with headquarters at Bradford, Pa.

California Eastern.—Mr. D. S. Scofield has been elected First Vice-President and Mr. W. N. Byers Second Vice-President and Treasurer.

Carolina Midland.—Mr. Isaac W. Fowler has been appointed General Manager, with office at Barnwell, S. C.

Central Railway of Guatemala.—Mr. A. C. Michaelis has resigned as General Manager.

Cincinnati, Portsmouth & Virginia.—Mr. W. B. Ruggles, Chief Engineer of this road, has resigned.

Cincinnati Northern.—Mr. Frank B. Drake, General Manager, has resigned and Mr. George L. Bradbury, General Manager of the Lake Erie & Western, will have his jurisdiction extended to carry on Mr. Drake's work.

Charleston & Western Carolina.—The officers of Auditor, E. W. Miller, and General Manager, W. J. Craig, of the Charleston & Western Carolina, which was recently purchased by the Atlantic Coast Line, have been abolished by President H. Walters, of the Atlantic Coast Line.

Cleveland, Akron & Columbus.—Mr. John H. Sample has been appointed General Superintendent, with office at Cleveland, Ohio.

Cornwall Railroad.—At a meeting of this company, held January 25, 1898, Mr. B. H. Buchingham was elected President.

Fitchburg.—At a meeting of the Directors held in Boston, Mass., February 15, Edmund Dwight Codman, heretofore Vice-President, was unanimously elected President.

Fonda, Johnstown & Gloversville.—Mr. J. Ledie Hess has been elected President, with headquarters at Gloversville, N. Y.

Fremont, Elkhorn & Missouri Valley.—Mr. F. M. Marsh has been appointed Chief Engineer, with headquarters at Omaha, Neb., to succeed Mr. J. B. Berry, resigned to go to the Union Pacific.

Great Northern.—Mr. George Dickson, General Foreman of the Locomotive and Car Shops, has been transferred to West Superior, where he takes charge of the company's mechanical department.

Guatemala Central.—Mr. Charles B. Chester, Master Mechanic of this road, died at Chattanooga, Tenn, January 8.

Gulf, Beaumont & Kansas City.—Mr. J. F. Weed has been appointed Chief Engineer, with headquarters at Beaumont, Tex.

Gulf & Interstate.—Mr. James Hickey has been appointed Master Mechanic, with headquarters at Beaumont, Tex.

Interoceanic Railway of Mexico.—Mr. H. E. Walker has been appointed Locomotive Superintendent, to succeed Mr. E. F. Sedgwick, resigned.

Maricopa & Phoenix & Salt River Valley.—Mr. B. F. Porter has been appointed Acting Superintendent, vice General Superintendent C. C. McNeil, resigned.

Mason City & Fort Dodge.—Mr. W. C. Toomey has been elected President.

Minneapolis & St. Louis.—Col. Wm. Crooks having resigned the office of Chief Engineer, that office has been abolished. Reports heretofore made to the Chief Engineer are now made to the General Manager.

Mississippi, Hamburg & Western.—Mr. L. A. Cole has been elected President, succeeding Mr. J. M. Parker, who has been appointed General Manager. Mr. Parker's headquarters are to be at Hamburg, Ark.

Mobile & Ohio.—General James C. Clarke has resigned the Presidency, but, upon the request of the Board of Directors, has consented to serve as a Director of the road.

New Orleans and Northwestern.—Mr. C. G. Vaughn has been appointed Chief Engineer, with headquarters at Natchez, Miss.

Norfolk, Willoughby, Spit & Old Point.—Mr. M. W. Burk has been elected Vice-President.

Omaha Bridge & Terminal.—Mr. John R. Webster has been appointed General Manager. He was formerly Assistant General Manager.

Pennsylvania.—Mr. Samuel Porcher has been appointed Purchasing Agent, to succeed Mr. A. W. Sumner, deceased.

Philadelphia & Reading.—Mr. H. H. Vaughan has been appointed Mechanical Engineer.

Pittsburg & Lake Erie.—Mr. J. M. Schoonmaker has been elected Vice-President and General Manager, Mr. G. M. Beach was appointed Assistant General Manager, and Mr. J. B. Yohe, General Superintendent.

Salt Lake and Ogden.—Mr. James M. Kirk has been appointed Master Mechanic, with headquarters at Salt Lake City, Utah, succeeding Mr. W. T. Godfrey, recently resigned.

San Francisco & North Pacific.—Mr. Andrew Markham has been elected Vice-President succeeding Mr. Philip N. Lilienthal.

Seattle & International.—The following officers have resigned, owing to the sale of that road to the Northern Pacific. Mr. John H. Bryant, President-General Manager; Mr. Charles Powers, Secretary and Treasurer; Mr. C. S. Mellen has been elected President.

St. Paul & Duluth.—L. S. Miller having resigned the office of Assistant General Manager has been abolished, and the duties of that position will hereafter be performed by A. B. Plough, Vice-President and General Manager.

Terre Haute & Peoria.—Mr. James T. Brooks has been elected Vice-President, succeeding Mr. J. J. Parrish.

Texarkana & Fort Smith.—Mr. Charles Snooks has been elected Secretary and General Manager.

Texas Central.—At the annual meeting recently held in Waco, Texas, Richard Oliver, heretofore Secretary, Treasurer and Auditor, was appointed General Manager, Secretary and Treasurer, succeeding Charles Hamilton, who remains as Vice-President.

Union Pacific.—Mr. George H. Pegram, Chief Engineer, has resigned.

Union Pacific.—Mr. John B. Berry has been appointed Chief Engineer, with headquarters at Omaha, Neb., vice Mr. George H. Pegram, resigned.

Waynesburg & Washington.—Mr. Joseph Wood has been elected President, succeding the late John E. Davidson. Two new Directors were also elected, Mr. Joseph Wood and Edward B. Taylor. Mr. J. J. Brooks was elected Vice-President.

Wheeling & Lake Erie.—Mr. E. X. Hermensader, of Massillon, Ohio, has been appointed Assistant Master Mechanic of the shops at Norwalk, Ohio, succeeding Mr. Bernard McGinn, assigned to other duties.

Wheeling Bridge & Terminal.—Mr. John A. Rutherford has been appointed Vice-President, with office at New York, vice Mr. C. H. Coit, resigned.

Wisconsin Central.—Mr. John A. Whaling has been appointed Purchasing Agent to succeed Mr. A. D. Allibone, resigned. Mr. Whaling occupied this position previous to January 1, 1896.

Wisconsin & Michigan Railway.—The office of General Manager has been abolshed and the jurisdiction of Mr. A. H. Crocker, Superintendent, has been extended to cover operation of its ferry line.